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**ASTRONAUTICS AND
AERONAUTICS, 1991-1995**

A CHRONOLOGY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA SP-2000-4028

ASTRONAUTICS AND AERONAUTICS, 1991-1995

A Chronology

Compiled by Ihor Y. Gawdiak and Charles Shetland

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Preface

This chronology of events in aeronautics, aviation, space science, and space exploration was prepared by the Federal Research Division of the Library of Congress and RSIS for the History Division of the National Aeronautics and Space Administration (NASA). It covers the years 1991-1995 and continues the series of annual chronologies published by NASA.

The present volume uses the format of the previous edition of this series, *Astronautics and Aeronautics, 1986-1990: A Chronology*. It also integrates, in the appendices, information presented in previous publications.

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January

January 1: Soviet space program experts announced that the 40-ton Soviet Space Station Salyut 7 would break up and fall to Earth in February. Tass, the official Soviet press agency, implied Soviet officials had lost control of the station when it said the authorities would issue a “timely warning” to all countries on whose territory station “parts are likely to fall.” Salyut 7 was launched in 1982 and last inhabited in 1986, holding up to six astronauts. The Soviet Union had planned to send a rescue mission with the Soviet Space Shuttle Buran but the Shuttle was delayed. (*NY Times*, Jan 1/91)

January 2: Massachusetts Institute of Technology physicist Alan Guth theorized that during a fraction of a second immediately after the explosion known as the Big Bang, the universe underwent phenomenal growth. It ballooned faster than the speed of light from being smaller than an atom to a size larger than astronomers can see with their most powerful telescopes. Nearly everything that now exists had its origin during this expansion, which Guth calls inflation. (*WSJ*, Jan 2/91)

January 3: NASA announced that it recently signed an agreement with the European Space Agency (ESA) to cooperate in developing the Cassini spacecraft to study Saturn. The Cassini spacecraft would consist of the Saturn Orbiter provided by NASA and the Huygens Probe System provided by ESA. It was scheduled for launch by NASA on a Titan IV/Centaur vehicle in April 1996. NASA would provide overall Cassini mission operations and ESA would support probe operations. The flight from launch to Saturn orbital insertion requires approximately seven years; once there, the mission baseline lifetime is four years. (NASA Release 91-1)

- The findings of the Infrared Astronomical Satellite have caused astronomers to question part of the Big Bang theory, according to a report by Dr. Will Saunders of Oxford University and his colleagues in the journal *Nature*. The cold dark matter model cannot explain the giant superstructures and companion supervoids found in galactic surveys. These structures appear too vast to have formed since the Big Bang. (*NY Times*, Jan 3/91; *W Post*, Jan 6/91; *LA Times*, Jan 4/91)

- Orbital Sciences Corporation in Fairfax County, Virginia was issued its first license for commercial space launches. The Department of Transportation licensed three launches to be used for experiments on the impact of weightlessness on payloads for the Center for the Commercial Development of Space at the University of Alabama in Huntsville. Orbital, which launched an experimental winged Pegasus rocket from a NASA B-52 bomber last year, was to use a different technology for the DOT-licensed flights. It would launch Prospector

rockets developed by the company from a Cape Canaveral, Florida, launch pad refurbished by Orbital. The first launch was scheduled for March 1991, followed by launches in December 1991 and December 1992. (*W Post*, Jan 3/91)

- NASA announced that in January 1991, it would conduct experiments from an orbiting satellite to test the possibility of creating an artificial aurora. The Combined Release and Radiation Effects Satellite (CRRES) was to release clouds of barium and lithium vapor in the Earth's magnetosphere, the region above the atmosphere.

The CRRES program is a joint NASA (through its Marshall Space Flight Center in Huntsville, Alabama)-U.S. Air Force (Department of Defense Space Test Program) effort to study the Earth's ionosphere and magnetosphere and to monitor the effects of the space radiation environment on sophisticated electronics. Through the CRRES program's artificial cloud-release experiments, scientists seek to understand the processes that cause auroras by using artificial charged-particle clouds to induce them.

Seven releases were planned, three in which lithium would produce a red glow and four of barium, which would glow green and purple. The possible dates for the releases were January 10, 12, 14, 15, 17, 19, 21, 23, 24, and 25. Exact times for the releases, which were to occur over South America at altitudes between 3,000 and 21,000 miles, were to be announced. (NASA Release 91-2)

- The Environmental Quality Permit Board for the State of Mississippi in Jackson approved an air emissions and waste water discharge plan of NASA, needed to test-fire rocket motors at the John C. Stennis Space Center near Bay St. Louis. Water quality certification remained to be granted. The Board had one opposing vote from the head of the Department of Wild Life because of NASA's plans to fill in 69 acres of wetlands and clear 150 to 200 acres. The official considered this plan contrary to the president's policy that there be no net loss of wetlands. (*Poplarville Democrat*, Jan 3/91)

January 4: James W. McCulla, Director of Media Services, NASA, replied to an op-ed article in the *Washington Post* by Jessica Mathews, vice president of World Resources Institute. Mathews maintained that there was no justification for the U.S. space exploration program now that the Cold War had ended. McCulla replied that learning more about the universe, Earth systems, and life beyond Earth were significant goals. (*W Post*, Jan 4/91; *P Inq*, Jan 4/91)

January 7: NASA named Margaret G. Finarelli as Associate Administrator for External Relations and John D. Schumacher as Deputy Associate Administrator for External Relations. Finarelli, who has served in a number of U.S. government agencies, joined NASA in 1981 as Chief of the International Planning and Programs Office. Schumacher came to NASA in 1989 from a law practice in New York City. (NASA Release 91-3)

- The *New York Times* reported that the United States would announce today at a scientific meeting in New Mexico its intention to buy an advanced Soviet nuclear reactor, known as Topaz 2, built to power systems in space. The United States at present has no working nuclear reactors in orbit and this purchase constitutes a high point in East-West cooperation on technical matters. Topaz 2 is designed to operate up to five years in space and will be set up in the Albuquerque area. It was to be tested by the University of New Mexico, the Sandia National Laboratory, the Los Alamos National Laboratory, and the Air Force Phillips Laboratory. The Topaz 2 can generate from 6,000 to 10,000 watts of electricity. (*NY Times*, Jan 7/91)
- An unmanned \$45 million Delta 2 rocket carrying a \$110 million NATO communications satellite to replace an older military spacecraft was launched on January 7 from Cape Canaveral Air Force Station in Florida. The rocket was built by McDonnell Douglas Space Systems Company and was the 202d launch of a Delta. The satellite, which would enable political and military leaders in the NATO area to communicate with one another, was the first of two advanced NATO 4 satellites built by British Aerospace. (*AP*, Jan 7/91; *NY Times*, Jan 9/91)
- An editorial deplored efforts of the Virginia congressional delegation to block NASA's possible closing of its Reston, Virginia, office. The editorial stated that to cut space program costs, which suffer from a bloated management structure, streamlining must occur and the Reston office was a good place to begin. (*Space News*, Jan 7-20/91)
- NASA scientist Thomas J. Miller said NASA would establish a Nuclear Propulsion Systems Office at Lewis Research Center in early 1991 to develop nuclear propulsion for spacecraft. The Defense and Energy departments would join in this project; the NASA FY 1991 budget included about \$1 million for nuclear propulsion development. Such propulsion could significantly reduce the time required from Earth to the Moon or Mars. (*AvWk*, Jan 7/91)
- The *Birmingham Post-Herald*, in a series of articles on the space program, expressed concern that quality assurance at the Marshall Space Flight Center in Huntsville, Alabama, had declined since the Apollo program, which was at its height in 1970. By 1989, contractor employees working on some 20 Marshall projects numbered 13,398, more than four times as many as the civil service staff. This meant that contracts sometimes could not be monitored closely, which probably was a factor in the cost overrun of the orbital maneuvering vehicle, leading to NASA's cancellation of the program. (*Birmingham Post-Herald*, Jan 7/91)
- NASA's Kennedy Space Center asked for proposals for a follow-on system to its Payload Data Management System (PDMS). The system was to be used

to manage data relating to payloads for Space Shuttles and ultimately for the Space Station. The new system, to cover a 10-year period, was to include a relational database management subsystem, a project management subsystem, a technical documentation subsystem, and a page printing subsystem. (*Federal Computer Week*, Jan 7/91)

- NASA's Goddard Space Flight Center in Greenbelt, Maryland, announced that it planned to request proposals for a study for the Space Network Control (SNC). If the SNC becomes a project, it would result in a new control center in time for the Advanced Tracking and Data Relay Satellite System (ATDRSS) in 1997 approximately. The ATDRSS would increase services and add more satellites. (*Federal Computer Week*, Jan 7/91)

- Kenneth Szalai, recently named Director of NASA's Ames-Dryden Flight Research Facility at Edwards Air Force Base, stated that NASA was putting a new emphasis on aeronautics. The facility's number one project involved the F-18 high-angle-of-attack program to help design more maneuverable aircraft. Similar work was underway on the X-29 as well as modifications on the F-15 jet fighter and testing of Space Shuttle landing gear systems. (*Antelope Valley Press*, Jan 7/91)

January 8: NASA announced that astronaut William F. Fisher, M.D., would resign effective January 31, 1991. He was to return to full-time medical practice in Texas. With NASA since 1980, Fisher took part in research and in the twentieth Space Shuttle mission in August 1985 when he engaged in the longest spacewalk in the history of spaceflight. (NASA release 91-4; UPI, Jan 8/91)

- In a commentary on the *Report of the Advisory Committee on the Future of the U.S. Space Program*, released in December 1990, Alston Chase pointed out that the report stressed that among NASA's major problems were that it "has grown too large and is trying to accomplish very complex tasks in which there is little margin for error." As an example of NASA's growth, the report cited that Viking involved some 13,000 people, whereas Apollo involved 180,000. (*W Times*, Jan 8/91)

- An article emphasized the problems of the Soviet space program arising from economic and political causes. The Space Shuttle, unveiled two years previously, had not yet carried astronauts into space. The 100-foot long Mir Space Station underwent repeated cuts and in 1988 the "permanent" Space Station was left empty for four months; recently, three-man crews were reduced to two. Military rocket launchings continue but space program funds were cut 10 percent two years in a row. As a result, the reusable Shuttle Buran, which was to rendezvous with Salyut 7 and bring it back to Earth, was unable to do so. Soviet efforts to fund the space program through foreign sales proved disappointing. (*NY Times*, Jan 8/91)

- Resigning astronaut Dr. William F. Fisher warned that the planned \$37 billion NASA Space Station could be canceled if its redesign is superficial. He stated that the Space Station needed total rethinking, adding that both Congress and a White House panel also indicated such a need. (*NY Times*, Jan 9/91)

- Whereas NASA's Goddard Institute for Space Studies in New York plans to announce that 1990 was the hottest year ever recorded, NASA's Marshall Space Flight Center in Huntsville, Alabama, says 1990 was only the fourth hottest year since 1979. The difference is accounted for by the fact that Goddard uses ground-based thermometers to record local heat while Marshall uses satellites, which broadly measure atmospheric temperature worldwide. In addition to the global temperature analysis, the World Resources Institute released two related studies. One was by Richard Heim of the National Oceanic and Atmospheric Administration's Global Climate Laboratory. (*WSJ*, Jan 8/91; *W Post*, Jan 10/91; *UPI*, Jan 10/91; *LA Times*, Jan 10/91; *CSM*, Jan 16/91; *NY Times Magazine*, Feb 3/91)

- The *Birmingham Post-Herald* expressed the concern of some NASA staff over the number of flight waivers NASA had issued. NASA issues such waivers on certain critical items rather than change the Shuttle design, which would be very costly. Statistics indicate that the number of waivers approved since the Challenger accident more than tripled. According to Frank Pizzano, head of the reliability and maintainability engineering division at Marshall Space Flight Center in Huntsville, Alabama, the increase results from stricter standards for waivers but many weaknesses were eliminated in the Shuttle redesign after the Challenger accident. (*Birmingham Post-Herald*, Jan 8/91)

January 9: NASA announced it modified its Space Shuttle orbiter production contract with Rockwell International Corporation, Space Systems Division in Downey, California. The modifications, at a cost of \$93.5 million, extend the mission duration of Columbia flights from 10 days to 16 days, plus a two-day contingency. Measures required include a regenerative carbon dioxide removal system, improved waste collection provisions, added gaseous nitrogen and crew stowage provisions, and additional power furnished by an Extended Duration Orbiter cryogenic pallet holding spherical tanks of liquid oxygen. (NASA Release C91-c)

- Construction of Endeavour, authorized by Congress in 1987, is 90 percent complete and at a cost of \$1.88 billion, not including main engines, was under budget and on schedule. Despite improvements, the command console technology is 20 years old to be consistent with other orbiters. Endeavour has the capacity of 28-day flights; the rollout date was scheduled for April 1991. (*CSM*, Jan 9/91)

- NASA planners discovered that despite the problems it encountered, Astro-1 brought back much valuable data on December 10, 1990. However,

there was no money in the FY 1992 budget for Astro-2. Instead, NASA appeared to be concentrating on such priorities as the Space Station program. The Astro program is Shuttle-dependent, with the assumption that the Shuttle would provide cheap and reliable space transportation. The Astro program needs to be reexamined. (CSM, Jan 9/91)

January 10: NASA stated that an artificial aurora borealis lasting from five to 15 minutes would be created by its satellite's release of chemicals the evening of January 10. The faux aurora is part of the Combined Release and Radiation Effects Satellite (CRRES) project of NASA and the Air Force, probing the Earth's magnetic field. (*W Post*, Jan 11/91; UPI, Jan 10/91; AP, Jan 11/91)

NASA announced in the early evening of January 10 that bad weather forced the cancellation of the planned event. (*W Post*, Jan 10/91; *P Inq*, Jan 10/91; *W Times*, Jan 10/91; AP, Jan 10/91; UPI, Jan 10/91)

- President George Bush and Vice President Dan Quayle received the crew of the Columbia Shuttle and their spouses. (UPI, Jan 10/91)

- NASA's Goddard Space Flight Center (GSFC), Greenbelt, Maryland, announced that Advanced Computer Systems, Inc. of Fairfax, Virginia, would provide administrative automated data processing services for GSFC's Information Management Division. The contract would take effect April 1, 1991, and would consist of a one-year basic period and four one-year priced options for a total of \$58.8 million. (NASA Release C91-d)

January 11: NASA Administrator Richard H. Truly announced additional actions to implement the recommendations of the Advisory Committee on the Future of the U.S. Space Program. Truly briefed the National Space Council on January 11 on the status of NASA's review. NASA decided as follows: Space science would remain NASA's priority and NASA would implement the existing strategic plan, as recommended by the advisory committee. In response to the committee's recommendation, NASA planned to form a special task force with the Department of Defense to assess development over the next two months of an evolutionary heavy-lift launch vehicle. Space Station Freedom restructuring activities, centering on life sciences on microgravity research and applications, conducted in concert with international partners, would be extended to incorporate the committee's recommendations. NASA would move with the Office of Personnel Management to structure a personnel management system that recognizes NASA's special needs to attract and retain top-flight scientists, engineers, and other specialists.

NASA had initiated a number of studies related to the report. In addition, it was to consider the committee's recommendations to conduct Mission to Planet Earth as "a constantly evolving program"; reestablish research and development to support operational government environmental satellites; develop an agency-wide space technology plan to enable future NASA missions and spur commercial space activities; and make certain organizational changes at NASA, e.g.,

the creation of an *Office of Exploration* and an *Office of Human Resources*. (NASA Release 91-5; AP, Jan 11/91; *Space News*, Jan 21-Feb 3/91)

January 12: The first release of barium vapor, creating a green cloud, by the Combined Release and Radiation Effects Satellite occurred the evening of January 12, NASA announced. The second release consisted of lithium vapor the night of January 13, causing a red cloud. (*P Ing*, Jan 14/91; *USA Today*, Jan 14/91; *NY Times*, Jan 14/91; AP, Jan 13/91; UPI, Jan 12/91; *W Post*, Jan 13/91)

- An international conference at the University of California San Diego, sponsored by the university's Institute on Global Conflict and Cooperation, the California Space Institute, and Los Alamos, New Mexico's National Laboratory Center for National Security Studies expressed concern over the rising cost of space exploration and the difficulty of justifying such costly ventures as sending humans to Mars. Roger Bonnet, chief scientist of the European Space Agency, which cooperates with the United States on the Space Station, regretted American hesitations on the Space Station. (*LA Times*, Jan 12/91)

January 13: Reporting on the huge volume of data being created daily by the government, the *Los Angeles Times* stated that NASA's Earth Observing System, set for 1998 launch, could generate the equivalent of all 15 million books in the Library of Congress every 12 weeks. (*LA Times*, Jan 13/91)

- Work done for NASA in connection with planning space habitats where people would live for years without a change of air revealed that potted plants, including their soil and microorganisms, act to "eat" pollutants commonly found in indoor air. (*LA Times*, Jan 13/91)

January 14: NASA's Cosmic Background Explorer (COBE), through its Far Infrared Absolute Spectrophotometer (FIRAS), mapped the distribution of nitrogen throughout our galaxy. The COBE team reported this information at the American Astronomical Society meeting in Philadelphia. These all-sky measurements are unencumbered by atmospheric and instrument emission and enable astronomers to understand better the processes occurring throughout the Milky Way. Scientists can measure the wavelength of emissions from ionized nitrogen atoms, the total energy of the galaxy, and test other theories. FIRAS is one of three instruments aboard COBE, NASA's first satellite primarily designed for cosmological studies. The data were analyzed at the Goddard Space Flight Center.

Scientists at the Philadelphia astronomical conference discussed the implications of COBE findings to date as they affected the Big Bang theory, the evidence of star clusters, and other cosmic structures, which present theories do not explain. The new observations were welcomed as putting astronomical work on a more scientific footing.

Scientists at the Philadelphia conference also discussed the report of the findings of the Japanese Ginga (Galaxy) satellite, concerning a very powerful

quasar output. The Japanese-American team spent a year verifying the measurements and believed that quasars lie at the center of certain galaxies and draw their power from black holes. It appeared that there might be more quasars and black holes than was previously believed.

In other conference discussions, German astronomers reported on the clustered quasars discovered by the Roentgen Satellite, or Rosat, designed and built by Germany and launched in June 1990 at Cape Canaveral, Florida. (NASA Release 91-6; *W Post*, Jan 15/91; UPI, Jan 14/91; *NY Times*, Jan 15/91; *B Sun*, Jan 15/91; AP, Jan 15/91; *LA Times*, Jan 15/91; *NY Times*, Jan 16/91; *W Post*, Jan 16/91; *B Sun*, Jan 16/91; *LA Times*, Jan 16/91; *C Trin*, Jan 16/91; *NY Times*, Jan 22/91; *W Post*, Jan 21/91)

January 15: NASA announced the selection of nine scientists as team members in the Search for Extraterrestrial Intelligence (SETI) Microwave Observing Project. The SETI project has two elements: Targeted Search and Sky Survey. The Targeted Search was to use the largest available antennas and search over a 1 to 3 gigahertz (GHz) frequency range, looking for patterns that could indicate an artificially generated signal. The search would conduct the most sensitive search yet conducted of nearby (less than 80 lightyears distant) solar-type stars. The Sky Survey would use the 34-meter antennas of NASA's Deep Space Network sites to scan the whole sky over a 1 to 10 GHz frequency range. The survey could detect signals from the vicinity of distant sunlike stars or from areas beyond the solar-type stars. SETI observations were to begin on Columbus Day 1992, with the Sky Survey deployed at Goldstone, California, and the Targeted Search mounted at the National Science Foundation's Arecibo Observatory in Puerto Rico.

NASA's Ames Research Center, Moffett Field, California, is managing the overall SETI project as well as the Targeted Search element. NASA's Jet Propulsion Laboratory, Pasadena, California, is managing the Sky Survey aspect. SETI is part of NASA's Exobiology Program of NASA's Office of Space Science and Applications. The scientists selected made research proposals to be accomplished by the SETI project and were to help SETI finalize some of the equipment designs and refine search procedures. (NASA Release 91-7)

- Ariane 44L, the most powerful rocket of the Ariane series of Arianespace, the commercial branch of the European Space Agency, blasted into space the night of January 15 from the northeast coast of French Guyana in South America. The rocket carried two European communications satellites: Italsat I, the first experimental communications satellite of the Italian Space Agency, and EUTELSAT II-F2, the second communications satellite of the European satellite organization. (*W Times*, Jan 16/91)

January 16: Dr. Sally Heap of NASA's Goddard Space Flight Center, Greenbelt, Maryland, reported to the American Astronomical Society meeting in Philadelphia that the High Resolution Spectrograph, an advanced instrument on NASA's Hubble Space Telescope, made the best spectrograms ever obtained

of Melnick 42. Melnick 42, some 80 to 100 times larger than the sun, is a massive star in a galaxy 170,000 light-years from Earth. The star, which is evolving toward a supernova state in the next few million years, is shedding its hot gases at a great rate in a "stellar wind" that strips the star of an amount of gas equal in mass to the sun every 100,000 years. The Hubble Space Telescope also revealed that the activity of pulsars inside a globular star cluster known as M15 was preventing the collapse of matter into a black hole and in some cases creating "born-again" pulsars in binary pairs form. (NASA Release 91-8; *NY Times*, Jan 17/91; *B Sun*, Jan 17/91; *USA Today*, Jan 17/91; *P Inq*, Jan 17/91; *W Post*, Jan 17/91; *AP*, Jan 16/91; *LA Times*, Jan 17/91; *W Times*, Jan 18/91; *P Inq*, Jan 18/91)

- NASA showed on closed-circuit television pictures taken by Magellan after it had passed the halfway point in its eight-month mission to photograph Venus. The Magellan flew over 50.9 percent of the planet's surface and made successful pictures of 41.4 percent of the terrain. NASA announced some of the findings regarding the surface of Venus and the effect of tectonics on January 25. (*AP*, Jan 17/91; NASA Release 91-12; *AP*, Jan 25/91; *NY Times*, Jan 26/91; *AP*, Jan 31/91)

January 17: NASA announced that the Combined Release and Radiation Effects Satellite (CRRES) would resume experiments after four successful chemical releases in the past week. The releases should aid in studying the way that charged particles interact with the Earth's magnetic and electric fields by creating artificial auroras. (NASA Release 91-9; *Time*, Jan 21/91)

- The Astro three ultraviolet and one x-ray telescopes carried by Columbia showed no traces of the decay processes of tiny invisible particles known as neutrinos, it was announced at the American Astronomical Society conference. These particles are connected with the Big Bang theory. (*NY Times*, Jan 18/91; *W Post*, Jan 18/91; *LA Times*, Jan 18/91; *C Trin*, Jan 20/91; *CSM*, Jan 23/91)

- NASA tightened security measures at its key facilities in the United States in the wake of the Persian Gulf War and the possibilities of terrorist activity. (*UPI*, Jan 17/91)

January 23: NASA lowered Lockheed Space Operations Company's overall annual rating from "excellent" to "very good," with the company receiving 89 out of a possible 100 points. The lower rating resulted from several Shuttle processing accidents, of which one related to Atlantis and three to Discovery. (*Fla Today*, Jan 23/91)

January 24: NASA technology developed by the Goddard Space Flight Center, Greenbelt, Maryland, designed sensors to monitor potentially damaging heat build-up in electronic circuits. Such technology was to be used in connection with the huge television Jumbotron screen for the Superbowl game on January

27. NASA's Technology Utilization program is cited as an example of the applications that can be made from NASA findings. (NASA Release 91-10)

- Scuba divers exercising on an underwater treadmill at NASA's Ames Research Center, Moffett Field, California, are helping gather data to be used in NASA's space suit design. (NASA Release 91-11)

- Navy Captain Michael L. Coats, the astronaut to command the *Discovery* mission, said that astronauts in *Discovery*, although with no military charge, would seek to observe the Persian Gulf War in their flight. The *Discovery's* military payloads would provide data to help the United States detect missiles fired in future wars. (*H Post*, Jan 24/91)

January 25: NASA announced that it had signed an agreement with the National Science Foundation (NSF) by which the two organizations would use Antarctica as a testing site to prepare for future missions to the Moon and Mars. The agreement would enable NASA to benefit from NSF's 33 years of experience in scientific research in the harsh Antarctic environment. Scientists believe that Antarctica's climate, terrain, temperature, and isolation provide an environment on Earth that most closely parallels the conditions of isolation and stress to be faced on long-duration human missions in space. (NASA Release 91-13)

- NASA Administrator Richard H. Truly said that NASA would ask Congress to increase its budget by 13 percent in the next fiscal year, emphasizing projects with short-term ecological benefits and helping schools and teachers to encourage students with an aptitude for mathematics and science. Truly added that manned space flights would be downgraded in importance compared with unmanned programs and pure scientific research, particularly research that would benefit the life sciences and development of a new rocket engine. (*SF Chron*, Jan 25/91)

January 26: Soviet media reported that two Soviet cosmonauts spent six hours on a spacewalk outside their Mir Space Station, completing the installation of two telescopic booms that would enable the transfer of solar batteries from one part of the Space Station to another. They also installed laser reflectors that could be used as beacons for unmanned space ferries and space shuttles arriving at Mir. (AP, Jan 26/91)

- NASA Administrator Richard H. Truly gave an interview to *Space News* about NASA's role in promoting space education and the Agency's future plans. One of the difficulties is attracting greater numbers of women and minorities. He discussed NASA's plan to establish a new office of human resources and the need for more people schooled in Earth sciences. In an editorial in the same issue, the publication commended NASA for its attention to education in high-technology fields and efforts to recruit women and

minorities. It also pointed out the number of laid off workers in the aerospace industry as a result of the sharp downturn in the defense industry as potential employees in the space field. (*Space News*, Feb 4-10/91)

January 27: The *Houston Chronicle* interviewed a number of experts concerning NASA's Space Station redesign, based on a congressional instruction that the design be reviewed. The consensus was that as much of the existing design would be kept as possible, with some experts fearing that the changes may be too timid. (*H Chron*, Jan 27/91)

January 28: NASA announced that the University of Tennessee-Calspan's Center for Advanced Space Propulsion (CASP), Tullahoma, had selected three firms for the launch and recovery of the unmanned, Earth-orbital Commercial Experiment Transporter (COMET) space system. Space Industries, Inc., Houston, would be responsible for payload integration, orbital operations, and recovery system and services; Space Services, Inc., Houston, would be in charge of the launch vehicle and services; and Westinghouse Electric Company, Millersville, Maryland, would supervise systems engineering and the service module. The initial funding for COMET in 1991 was \$10.5 million. (NASA Release 91-14)

- NASA Administrator Richard H. Truly issued a message to all NASA staff on the fifth anniversary of the Space Shuttle Challenger accident. He cited the important lessons learned, the stress on flight safety, and the successful Shuttle missions since that time. (NASA Release N91-8)

January 29: NASA announced the selection of 39 research proposals for negotiation of Phase II contract awards in NASA's Small Business Innovation Research Program (SBIR). SBIR seeks to stimulate technological innovation, increase the use of small business in meeting federal research and development needs, and increase private sector commercialization of results of federally funded research. The awards included 36 small, high technology firms located in 17 states and were valued at about \$19 million. (NASA Release 91-15; *Huntsville Times*, Jan 29/91)

January 30: NASA announced that the next Shuttle launch, scheduled for late February, would be delayed until early March in order to replace three thrusters used to steer the ship in orbit. During the eight-day flight, the 44 thrusters would be used to maneuver the ship into unusual positions. The ship's reentry engines also would be fired so a satellite temporarily placed in orbit could observe the rocket exhaust plumes. The aim was better identification of the plumes of missiles aimed against the United States in future wars. NASA also displayed the Gamma Ray Observatory scheduled to be carried into orbit in early April. (*P Inq*, Jan 30/91; *B Sun*, Jan 30/91; *USA Today*, Jan 30/91; AP, Jan 30/91; *NY Times*, Jan 31/91)

- NASA announced that the Ohio State University's Center for Mapping, Columbus, one of 16 NASA Centers for the Commercial Development of Space, had developed a system that would reduce the amount of time and money needed to gather information on highway conditions. The system uses both positioning data from the Defense Department's Navstar Global Positioning Satellite Systems and images taken from a pair of video cameras mounted in a standard van. The system would help locate roads needing repair and other hazardous conditions, including the location of fatal accidents. The 18-month project, called the Global Positioning System for Transportation Planning, involved the Federal Highway Administration, 38 state transportation departments, and the Canadian province of Alberta. The states had contributed \$565,000 to the project, and NASA had given \$280,000. The system also is ideal for mapping and the mobile unit enables digitizing to be done immediately. (NASA Release 91-16)

February

NASA has developed a biological system for treating wastes, using aquatic plants to recycle human waste on space stations. This system is being adapted in the Appalachian highlands of Virginia. Monterey began running its waste through ditches filled with rocks and planted with indigenous bulrushes. The state health department recently pronounced this “microbiological filter” a success and it is considerably cheaper than traditional waste treatment systems. However, artificial marshes need 20 times as much land as mechanical systems, limiting their potential in urban areas. (*Virginia Business*, Feb 91)

February 1: Robert Gibson, an astronaut removed from command of a Shuttle mission for violating flight-safety rules, unofficially has set a new altitude record of 27,000 feet in a single-engine Cassutt Formula 1 “midget” racing plane. (UPI, Feb 1/91; *LA Times*, Feb 3/91)

February 2: *Red Star* announced that pieces of the Soviet 40-ton Salyut 7 Space Station and the attached Cosmos-1686 cargo ferry will fall to Earth on February 6 or 7. The expected location of the fall site was not known. (*LA Times*, Feb 1/91; AP, Feb 2/91; *C Trin*, Feb 3/91; *W Times*, Feb 4/91)

- Orion Network Systems of Rockville, Maryland, has been gradually creating a private satellite communications network for businesses in the United States and Europe. It was awaiting approval for its financing from the Federal Communications Commission. The satellites were to be built by British Aerospace Limited and the launch was to be handled by General Dynamics Commercial Launch Services of San Diego, which would use Atlas rockets. (*W Post*, Feb 2/91)

February 4: NASA announced its Mixed Fleet Manifest for the Space Shuttle and expendable launch vehicles (ELVs) for the next three years. Of the 26 Space Shuttle flights, 18 would be for NASA payloads or joint NASA/international payloads. The Shuttle was to focus on a variety of space science activities supporting life sciences, materials science, and astrophysics investigations. The remaining flights would consist of two international Spacelab missions, two flights of the commercially provided Spacehab module, the retrieval and reboost of a stranded commercial communications satellite, and three Department of Defense (DoD) missions. There were 7 Space Shuttle launches planned for 1991, 8 in 1992, and 11 in 1993.

The first Space Shuttle launch in 1991 was scheduled to be the STS-39, an unclassified Defense Department mission carrying payloads belonging to the Air Force and the Strategic Defense Initiative Organization. NASA's Gamma Ray Observatory was planned for launch in April, and the first Spacelab Life

Sciences mission was planned in May aboard orbiter Columbia. The remaining flights were the fifth Tracking and Data Relay Satellite in July, a DoD Defense Support Program satellite in August, NASA's Upper Atmospheric Research Satellite in November, and the first International Microgravity Laboratory spacelab mission in December.

Thirteen ELV launches were to occur over the three years. During the period, various activities to support Space Station Freedom were to be performed. These included two flights with planned space walks to test planned Space Station equipment and techniques, two zero-gravity thermal system tests, and two tests of environmental control systems. (NASA Release 91-18)

- The 10-day UN conference on global warming opened on February 4 in Chantilly, Virginia. The conference was to discuss the greenhouse effect and worldwide temperature rises. For the first time, the United States pledged at the conference to stabilize the amount of "greenhouse" gases it emits into the air. (*W Post*, Feb 3/91; *USA Today*, Feb 4/91; *B Sun*, Feb 5/91; *NY Times*, Feb 5/91; *W Post*, Feb 5/91; *W Times*, Feb 5/91; *LA Times*, Feb 5/91)

- The Jet Propulsion Laboratory (JPL) in Pasadena, California, began analyzing the photos of Venus produced by the Magellan Spacecraft. JPL operates Magellan for NASA. The pictures show a tortured landscape featuring extreme volcanism, particularly surface bulges 30 to 140 miles wide called "arachnoids." (*LA Times*, Feb 4/91)

February 5: The Bush Administration proposed \$14.7 billion for NASA for FY 1992, an increase of \$1.2 billion. The proposal would allow starting a new family of rockets to lift heavy payloads. The budget would also authorize NASA and the Air Force to spend \$175 million each to develop a new launching system by the end of the 1990s. The Administration also proposed almost \$2 billion to continue development of a Space Station and almost \$1 billion for NASA's "Mission to Planet Earth" as part of the study of global environmental change. (*NY Times*, Feb 5/91; *USA Today*, Feb 5/91; *WSJ*, Feb 5/91; *UPI*, Feb 4/91; *UPI*, Feb 5/91; *Fla Today*, Feb 7/91)

February 6: Soviet Space Station Salyut 7 was expected to fall today. Unexpectedly high solar activity in recent years had increased atmospheric drag on the station and speeded its orbital decay. (*NY Times*, Feb 6/91; *USA Today*, Feb 6/91; *UPI*, Feb 6/91)

- NASA announced it would be a major participant in the multi-agency High Performance Computing and Communication (HPCC) to begin in FY 1992. NASA had the lead role in coordinating interagency software and algorithm research and development. In this connection, NASA would buy advanced test beds from industry and use test beds developed by the Department of

Defense to evaluate and build initial applications. NASA would also develop software to solve major computational challenges involved with robotic design and control. NASA centers would be equipped with the latest network communications to support the National Research and Education Network and NASA would expand the HPC research program of NASA-funded research institutes and through NASA grants to universities.

Another NASA project was Remote Experimentation and Exploration (REE), designed to develop a prototype high performance computing system to support future space missions. Such autonomous systems would be needed, for example, in explorations of Mars because of the distance from earth. (NASA Release 91-20)

- NASA Administrator Richard H. Truly announced the selection of 26 Space Grant Consortia as a result of Phase II competition. Recipients receive four-year, \$150,000-per-year grants to initiate new programs. States receiving such grants were Alaska, Delaware, District of Columbia, Indiana, Kansas, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, North Carolina, Oregon, Rhode Island, and Wisconsin. Twelve states with limited aerospace activity would receive similar grants to enhance aerospace research and infrastructure. They were Arkansas, Connecticut, Idaho, Louisiana, Maine, Montana, Nevada, North Dakota, Oklahoma, South Dakota, South Carolina, and West Virginia. Both grants require partial matching nonfederal funds and would be used in part to sponsor fellowship programs for undergraduate and graduate students. (NASA Release 91-19)

- NASA announced it had modified its Space Shuttle contract with Rockwell International Corporation's Space Division at an additional cost of \$27.6 million. The modification entailed the design, fabrication, testing, and installation of main propulsion system 14-inch disconnects into orbiter umbilicals in order to increase flight safety. Two other companies were involved in the work: Parker Hannifin and Martin Marietta. (NASA Release C91-g)

- NASA announced its award of a \$191 million, five-year contract to Krug Life Sciences, Houston, for medical operations and research support services. The work, covering the period March 1, 1991 through February 29, 1996, was to be done at Johnson Space Center, Houston. (NASA Release C91-f)

February 7: NASA Administrator Richard H. Truly briefed members of the House of Representatives Committee on Science, Space, and Technology on the President's 1992 budget request of \$15.7 billion for NASA, a 13.6 percent increase from the 1991 budget. Programs emphasized were the New Launch System to be developed with the Department of Defense; LIFESAT, a reusable biosatellite; Mission to Planet Earth, which shows commitment to the ecology; and a 17 percent increase for NASA's educational activities. (NASA Release 91-21)

- NASA announced that two additional releases, one of barium and one of lithium, would be made during February as part of the Combined Release and Radiation Effects Satellite (CRRES). CRRES was a joint NASA-US Air Force program to study the Earth's magnetic fields and the effect of space radiation on spacecraft components. (NASA Release 91-22; AP, Feb 7/91)
- The report of the committee appointed by the Bush Administration, headed by Norman R. Augustine, chairman of Martin Marietta Corporation, produced favorable comments from industry, according to the *New York Times*. Industrialists believe that the report showed greater realism about the space program, with its emphasis on unmanned flights and request for larger funding for NASA. In contrast to this complimentary review, Alcestis Oberg in *Space News* maintained that the Augustine panel's recommendations were irrelevant and a new agency was needed to pursue moon and Mars initiatives. (*NY Times*, Feb 7/91; *SP News*, Feb 4-10/91)
- NASA announced that the Magellan spacecraft was overheating because of dust or corrosion on its mirrors. Nevertheless, it should be able to map 95 percent of Venus. (*WSJ*, Feb 7/91; *USA Today*, Feb 7/91; AP, Feb 7/91)
- Salyut 7, the Soviet Space Station, crashed into Earth's atmosphere near Argentina's border with Chile. Powered by solar energy and chemical batteries, it contained no nuclear fuel or other dangerous substances. (*P Inq*, Feb 7/91; AP, Feb 7/91; UPI, Feb 7/91; *W Times*, Feb 8/91; *NY Times*, Feb 8/91; UPI, Feb 8/91; AP, Feb 8/91; *C Trin*, Feb 8/91)
- An editorial in *Florida Today* referred to NASA Deputy Administrator J.R. Thompson's comment about NASA giving serious consideration to consolidating Shuttle operations at Kennedy Space Center. He estimated this would cut Shuttle costs by 25 percent. Such a move would also result in consolidating Shuttle management, as recommended in the Advisory Committee report. (*Fla Today*, Feb 7/91)
- *Washington Technology* reported that a major effort is underway to move NASA's Space Station program office to a site near Goddard Space Flight Center (SFC) in Greenbelt, Maryland. Other sites being considered are Johnson SFC near Houston or Marshall SFC in Huntsville, Alabama. (*Washington Technology*, Feb 7/91)

February 8: Long Duration Exposure Facility (LDEF) chief scientist William Kinard of NASA's Langley Research Center in Hampton, Virginia, revealed that 200 experimenters in nine countries were analyzing the data gathered by the LDEF satellite that Space Shuttle Columbia rescued in 1990. The plan was to retrieve LDEF after 11 months, but delays and loss of Challenger stranded LDEF for five years and nine months. Nevertheless,

experiments were conducted and interesting findings were being discovered. (CSM, Feb 8/91)

- Jim Gunn, an astronomer at Princeton University and designer of equipment for the Digital Sky Survey, was planning a map of the universe that would fit in a desk drawer. Based on Gunn's work on the Hale telescope in California, the Sky Survey's 100-inch "smart" telescope would perch on top of the Sacramento Mountains in New Mexico. (*W Times*, Feb 8/91; *LA Times*, Feb 17/91)

February 10: Lowell Hawkinson, chairman of the Gensym Corporation of Cambridge, Massachusetts, which created the G2 system, announced that Biosphere II, would be initiated in March. Biosphere II is an environment controlled by the advanced computer program G2 and designed for eight scientists to seal themselves inside for two years. NASA had been using G2 on its Shuttle flights to control certain functions since October 1989. According to Tony Heindel, a light controller at Mission Control at the Johnson Space Center in Houston, G2 monitors 16,000 data points per second, gathering such information as temperature, voltages, availability of jet thrusters, and condition of on-board computers and instruments. (*NY Times*, Feb 10/91)

- The *Philadelphia Inquirer* reviewed *The Steel Albatross*, a novel about an underwater craft undetectable by sonar, just published by NASA astronaut Scott Carpenter. Concurrently, it reviewed *Aurora 7*, an account of the way in which various actual and fictional people were affected by Carpenter's flight in the Aurora 7 space capsule. (*P Inq*, Feb 10/91; *W Post*, Feb 17/91)

February 11: NASA announced that the German Roentgen Satellite (ROSAT) began a new phase of operation on February 8. It started pointed observations of x-ray emissions coming from celestial systems with high energy phenomena. The US ROSAT Science Data Center at the Goddard Space Flight Center, Greenbelt, Maryland, will process and distribute ROSAT pointed data and provide facilities for the scientific analysis of the data. Britain is also cooperating in this venture, which involved the original ROSAT launching from Cape Canaveral, Florida on June 1, 1990 on a Delta expendable launch vehicle. (NASA Release 91-23)

- Wayne Littles, head of the NASA Marshall Space Flight Center office charged with designing a heavy-lift launch vehicle for military and NASA purposes, commented on work underway. Still in the early stages, the heaviest lift models would carry at least 200,000 to 250,000 pounds. New advanced solid rocket boosters were planned as well as work on developing an unmanned version of the Shuttle, called Shuttle C. (*Birmingham Post-Herald*, Feb 11/91)

February 12: NASA Administrator Richard H. Truly announced a nationwide search for a senior official to direct NASA's activities to send people to the

Moon and to explore Mars. This announcement represented an implementation of a recommendation of the Advisory Committee on the Future of the U.S. Space Program to create a new Office of Exploration under an Associate Administrator. (NASA Release 91-24)

- The NASA Advisory Council of 25 leaders in industry, government, and academia sent a letter to Vice President Dan Quayle commending NASA Administrator Truly's quick action in implementing the *Report of the Advisory Committee on the Future of the U.S. Space Program*. (NASA Release N91-10)
- The National Space Council, headed by Vice President Quayle, developed a policy directive intended to strengthen the Nation's commercial space industry. The policy creates guidelines requiring the government to act more like a private business in dealing with space-related enterprises. It calls for increased efforts to negotiate trade agreements to reduce or eliminate subsidies provided by foreign governments, including the Soviet Union, China, and Japan, to their commercial satellite-launching services. The policy would also encourage government agencies, particularly NASA and the Defense Department, to support space activity by entering into cooperative research and development efforts with private industry and assuming some of the financial risk; basing contracts with rocket and satellite makers on "performance standards" rather than complex military specifications; and taking into account the government's overhead and development costs in assessing bids by private firms. (*P Inq*, Feb 12/91; UPI, Feb 13/91)
- An ongoing NASA project released a lithium canister from a satellite, producing a red sphere. Rick Howard, one of 40 scientists working on the project, said the purpose was to try to inject an artificial lithium plasma cloud to see if precipitation can be increased. (AP, Feb. 12/91)

February 13: The *Christian Science Monitor* discussed the cases of Ulysses, a joint mission of NASA and the European Space Agency (ESA), and Hipparcos, an ESA satellite. Ulysses, which was designed to study the environment over the north and south poles of the sun, developed a wobble that threatened its usefulness, but the problem was resolved. Hipparcos was designed to measure the positions, motions, and distances of more than 100,000 stars. It also developed orbit problems but to date has measured more than 1 million stars. (CSM, Feb 13/91)

- President Bush's 1992 budget included a proposed \$15.7 billion for NASA, representing 8.5 percent real growth after inflation. The request contained no new projects except for \$175 million for start-up work on a more cost-effective system of launch vehicles, as recommended by the Advisory Committee. (*W Post*, Feb 13/91)

February 14: NASA General Counsel Edward Frankle announced that Johnson Space Center's Leo Monford was NASA's Inventor of the Year. The award, to be presented March 28, was for a docking alignment system called Targeting and Reflective Alignment Concept, or TRAC. Used in combination with another of Monford's inventions, a Magnetic End Effector, it could change the shape of future robot arms, satellites, and Space Stations.

- University of Colorado astronomer Jack Brandt talked of the discoveries of the Hubble Space Telescope, in spite of its fuzzy focusing. Discoveries included proof that Pluto has a moon and dramatic photographs of a star spewing hot gases during its birth in the Orion constellation. (*W Times*, Feb 14/91)
- John Guest, a geologist from University College, London, was working at NASA's Jet Propulsion Laboratory on data from the Magellan spacecraft's mission to Venus. Evidence of volcanic action exists although Magellan's mapping mission, begun September 15, 1990, thus far reveal no volcano erupting. (*AP*, Feb 14/91)
- NASA officials announced that its X-29 experimental aircraft flew five times on January 25, setting a new record for daily flights from the Ames-Dryden test center. The second of two X-29s built by NASA, it was conducting high angle of attack test studies and military utility in a joint project with the Air Force. (*Antelope Valley Press*, Feb 14/91)

February 15: NASA officials at Goddard Space Flight Center, Greenbelt, Maryland, announced the termination of the contract with General Electric Company, Astro-Space Division, for the design, development, and testing of the Attached Payload Accommodation Equipment (APAE) element of Space Station Freedom. A congressionally mandated review of the Freedom program contributed to the APAE termination. (NASA Release 91-27)

- The *Washington Times* cited a congressional report, *Orbiting Debris: A Space Environmental Problem*, by the Office of Technology Assessment. The report warned of problems to space missions from debris in space and the need for international negotiations in this regard. (*W Times*, Feb 15/91; UPI, Feb 19/91)
- The 10-day global warming conference of some 100 nations ended with little agreement. Delegates agreed to establish two working groups to consider a draft of a treaty at a second round of talks later in 1991. The United States and other countries hesitated to commit themselves on specific emission reductions. (*W Times*, Feb 15/91; *USA Today*, Feb 15/91; *W Post*, Feb 15/91)
- The media reported that Shuttle Discovery was hauled to its launch pad at Cape Canaveral, Florida. Scheduled for a March blastoff, its mission was to

learn more about how to detect rockets in flight, part of the Strategic Defense Initiative missile defense program. (UPI, Feb 15/91; *LA Times*, Feb 16/91)

February 17: NASA Combined Release and Radiation Effects satellite released a barium canister to gain data about the magnetosphere and more reliable predictions of magnetic disturbances in space. (AP, Feb 17/91; *W Times*, Feb 18/91)

February 18: Stanley G. Rosen, retired director of long-range planning for the U.S. Air Force Space Division in El Segundo, California, and vice president for public policy of the American Institute of Aeronautics and Astronautics, said the Persian Gulf War demonstrated the need for radar satellites. Such satellites could penetrate clouds and battlefield smoke as well as monitoring all troop movements and could possibly detect Scud missile launchers. (*LA Times*, Feb 18/91)

- An editorial commended the guidelines for invigorating the commercial space industry developed by the National Space Council and signed by President George Bush. Although stating that the guidelines would be difficult to follow and tough to enforce, it found the government's definition of a commercial venture helpful as well as the expansion of cooperative programs between the government and the private sector in commercial space. (*SP News*, Feb 18-24/91; *AvWk*, Feb 18/91)

- William Lenoir, NASA Space Flight Chief, outlined the revised plans for the Space Station to the National Space Council on February 5. The revision would save \$6 billion over five years and would cut in half the number of astronauts to live aboard as of September 1999. The new design would assemble the station in larger pieces on the ground, thus requiring 23 Space Shuttle flights to build instead of the original 34 flights. The plan is due to Congress on March 5 but may be extended to a later date. (*SP News*, Feb 18-24/91)

- The Office of Management and Budget (OMB) ordered an independent engineering review of NASA's plans for the Earth Observing System to study global climate change. An Administration official said OMB wanted an assessment of the advisability of large, complex satellites and of the specific sensors and launch plans. (*AvWk*, Feb 18/91)

February 19: NASA's Kennedy Space Center, Florida, awarded Metric Constructors, Inc., of Tampa, a \$56,215,000 contract to build the Space Station Processing Facility. The 457,000-square-foot facility was to contain preflight and processing points for Space Station Freedom as well as 63,000 square feet of dedicated payload processing space. (NASA Release C91-h)

- NASA Goddard Space Flight Center, Greenbelt, Maryland, Director John M. Klineberg announced that Peter T. Burr had been named Deputy Director of

the Center. Burr had served as Director of Flight Projects at Goddard since August 1989. (NASA Release 91-28)

- NASA released its first in a new series of educational video products entitled "Space Basics," illustrating orbital science. A teacher's guide is also available. NASA planned that each future Shuttle mission would have a teacher's guide, "Mission Watch," and, following the mission a summary report, "Mission Highlights." (NASA Release 91-29)

- NASA officials reported that a quality inspector had discovered a cracked hinge in a fuel line door of Shuttle Discovery. The effect of the finding on Discovery's tentative launch date of March 9 was unknown. (UPI, Feb 19/91; AP, Feb 19/91; *B Sun*, Feb 20/91; *W Post*, Feb 20/91; *NY Times*, Feb 20/91; *WSJ*, Feb 20/91; *USA Today*, Feb 20/91; *W Times*, Feb 20/91; UPI, Feb 20/91)

February 20: The Fairfax County Board of Supervisors passed a resolution asking state and federal legislators to block a proposal to move NASA's Space Station program office out of Reston, Virginia. (*Fairfax Journal Weekly*, Feb 20-21/91)

- An article on the Hubble Space Telescope commented that despite its flawed main mirror, the teamwork of the Hubble operational team combined with elaborate computer processing had enabled a rich scientific harvest. (CSM, Feb 20/91)

February 21: NASA Administrator Richard H. Truly was scheduled to teach ninth grade geometry students at George Washington Junior High School, Alexandria, Virginia, on February 22. Selected as an "All-Star" engineer by the National Engineers Week 1991 committee, Truly was to share his engineering and aerospace knowledge with students. Astronauts Mary Cleave and Bonnie Dunbar were among the more than 10,000 engineers participating in the teaching program. (NASA Release N91-13)

- Scientists from several U.S. government and university laboratories reported finding the rare atmospheric isotope Beryllium-7 present on the surface of NASA's Long Duration Exposure Facility (LDEF). Dr. Gerald J. Fishman of NASA's Marshall Space Flight Center, Huntsville, Alabama, commented on the significance as twofold: to date, the isotope is known to be produced at much lower altitudes than the LDEF was orbiting; and only one atmospheric gas, atomic oxygen, is previously known as interacting with orbiting spacecraft. The LDEF was returned from space by Space Shuttle Columbia in January 1990 after nearly six years in Earth orbit and was still being analyzed. The LDEF program was managed by NASA's Langley Research Center, Hampton, Virginia. (NASA Release 91-30)

- Data analysis of cracks on the external door mechanism of Discovery continued, and fuel will be loaded without a decision as to whether the launch

would proceed on schedule. The door mechanisms of Space Shuttles Atlantis and Columbia were also examined, and cracks were discovered on Columbia. (NASA Release, Feb 21/91; *C Trin*, Feb 22/91)

February 22: Dr. Steve Saunders, Project Scientist at NASA's Jet Propulsion Laboratory, Pasadena, California, announced that Magellan to date had mapped more than 58 percent of Venus, including Aphrodite Terra, the largest of the highland regions. Various hypotheses exist regarding the formation of the different "continents" on Venus, and the mapping should clarify the situation. (NASA Release 91-31)

- The Soviet bank, Moscow Narodny, financing the May Anglo-Soviet mission aboard the Soviet Mir Space Station, announced that Helen Sharman, a chemist, would be Britain's first astronaut. (AP, Feb 22/91; *LA Times*, Feb 23/91)

- Scientists from NASA's Goddard Space Flight Center in Greenbelt, Maryland, reported that the ozone hole over the South Pole did not appear to be improving. The ozone loss in 1990 equaled the previous low detected in 1987 in "depth, duration, and area." The findings were based on NASA's satellite observations of a complete cross section of the ozone layer. The findings complemented measurements at certain altitudes taken by the National Oceanic and Atmospheric Administration's sounding balloons. (UPI, Feb 22/91)

- NASA announced its closing for security reasons of the public viewing site for watching Space Shuttle landings at Edwards Air Force Base until the end of the Persian Gulf War. (*Daily News*, Feb 22/91)

February 23: Nippon Television Network asked to borrow from the Smithsonian the Space Shuttle Enterprise, an Apollo capsule, a moon conveyor vehicle, a rocket, and a space suit. The Enterprise is stored at Dulles Airport and transporting it—on the back of a 747 or by ship would be difficult. The space gear was to be used to celebrate the company's fortieth anniversary in Tokyo in 1993. (*W Post*, Feb 23/91)

February 25: *Nature* quoted scientists at NASA's Atmospheric Sciences Division in Hampton, Virginia, as reporting that forest fires—previously thought to be a major source of nitrous oxide—actually produce only about seven percent of the amount in the atmosphere. The importance of the source of nitrous oxide relates to its action in the destruction of Earth's ozone layer. (*W Post*, Feb 25/91)

- Bill Moyers, a member of a national panel of experts involved in Project Censored, a compendium of the most underreported stories of 1990, dealt

with NASA and the ozone. Soviet scientists first raised environmental questions about the solid rocket fuel used by the Space Shuttles. They said it left 250 tons of hydrochloric acid eating up the ozone layer after every launch. The *Earth Island Journal* and the *San Francisco Chronicle* reported the story. On the program, environmental activist Helen Caldicott spoke of chlorine molecules that chomp up ozone molecules. (*P Inq*, Feb 25/91)

February 26: NASA announced that Joust 1, a commercial suborbital rocket carrying 10 materials and biotechnology experiments, would be launched on March 29 from Cape Canaveral, Florida. The mission was sponsored by the University of Alabama in Huntsville's Consortium for Materials Development in Space (UAH CMDS), a NASA Center for Commercial Development of Space. Space Data Division of Orbital Sciences Corporation would provide rocket and launch services to lift the payload approximately 400 miles into space. In addition to UAH CMDS, four other NASA commercial development centers and two industrial firms were involved. (NASA Release 91-33)

- Eugene Kranz, Director of the Mission Operations Directorate (MOD) at Johnson Space Center, Houston, announced the establishment of a Space Station Mission Operation Project Office within MOD. The new office, headed by Charles R. Lewis, was to have responsibility for the development and implementation of Space Station Freedom flight operations. (NASA Release 91-35)

February 27: NASA announced the signing of an agreement between the United States and Canada to participate in a five-year RADARSAT Earth-observation satellite mission. NASA Administrator Richard H. Truly was one of the United States signers. RADARSAT was scheduled for launch in June 1994 using an expendable launch vehicle provided by NASA. RADARSAT would collect valuable economic and scientific data on ice and ocean surveillance and natural resource management, including surveillance of natural disasters. (NASA Release 91-34)

- NASA announced that on February 21 test personnel at its John C. Stennis Space Center, Mississippi, had conducted a 1.5 second ignition test on a new turbopump developed by Pratt and Whitney for the Space Shuttle Main Engine. The company test program, underway since 1986, includes a partnership with Rocketdyne Division of Rockwell International. The pumps use newer design technology and materials. Stennis Space Center is NASA's facility for testing all Space Shuttle Main Engines that power the orbiter during its first 8 1/2 minutes of flight. (NASA Release 91-36)

- NASA managers were described as divided over whether Discovery could be safely launched on March 9 or needed to be taken off the launch pad and repaired. (UPI, Feb 27/91)

February 28: NASA announced that Administrator Richard H. Truly would present the 1990 George M. Low Trophy, NASA's Quality and Excellence Award, to Bob Minor, President, Space Systems Division, Rockwell International Corporation. The award, to be presented at company facilities in Downey, California, recognizes contractors for outstanding achievement in quality and productivity improvement and total quality management. (NASA Release N91-14)

- NASA announced its award of a \$38.5 million contract to RMS Associates, Linthicum, Maryland, to manage and operate the NASA Scientific and Technical Information Facility in Linthicum. (NASA Release C91-i)

March

March 1: William Lenoir, head of NASA's space flight program, announced that NASA was sending Space Shuttle Discovery from the launch pad back to the hangar to repair cracked door hinges. Shuttle Director Robert Crippen said Discovery should be ready to fly in late April or early May. (AP, Feb 28/91; *P Inq*, Mar 1/91; *NY Times*, Mar 1/91; *WSJ*, Mar 1/91; *W Times*, Mar 1/91; *USA Today*, Mar 1/91; *W Post*, Mar 1/91; UPI, Mar 1/91)

March 4: NASA announced its selection of Orbital Sciences Corporation (OSC), Fairfax, Virginia, for a contract to provide ocean color data. These data were to support research performed by the Laboratory of Hydrospheric Processes, Goddard Space Flight Center, Greenbelt, Maryland. The contract would run for about 7.5 years, of which 2.5 years would be development time and five years of data production. The mission's scientific objective was to measure changes in ocean color that indicate where concentrations of phytoplankton and chlorophyll lie on the surface of the ocean. For global change research, measuring concentrations of phytoplankton are essential in understanding the role of oceans in the global carbon cycle. The phytoplankton's photosynthesis stores vast amounts of carbon and understanding better how oceans store and release carbon will help understand global climate.

Commercial value of the data was the ability to pinpoint likely concentrations of fish. The mission was a further development of work done by the Coastal Zone Color Scanner, carried aboard the Nimbus-7 satellite. The interdisciplinary uses of data (oceanography, climatology) characterize NASA's Mission to Planet Earth. (NASA Release 91-37)

March 5: The *New York Times* carried an extensive article with diagrams describing many of the proposed reductions contemplated by NASA in the cost and role of its orbiting Space Station. The mission was to study the long-term effects of space on astronauts and other living things and to see whether the nearly weightless environment offers commercial possibilities. NASA was scheduled to deliver the modified proposal to Congress March 5. (*NY Times*, Mar 5/91; *W Times*, Mar 5/91)

- In a commentary originally for the *Christian Science Monitor*, Richard Minter cited the British television program, "The Greenhouse Conspiracy." The program highlighted the scientific uncertainties of global warming, relying on testimony from NASA experts, among others. (*B Sun*, Mar 5/91)

- NASA selected the 49-foot Pegasus rocket made by Orbital Sciences Corporation of Fairfax, Virginia, for seven launches worth about \$56 million, with an option for three more. This contract was additional to one for about \$43.5 million for ocean observation. (*W Post*, Mar 5/91)

- Ceremonies connected with NASA Administrator Richard Truly's presentation to Rockwell International Space Systems Division, Palmdale, of the 1990 George M. Low Trophy to a contractor for outstanding achievement in quality and productivity improvement were featured at some length. About half the Palmdale work force were scheduled to be laid off after Endeavour's completion; the remaining 450 workers beginning in July would modernize the Shuttle Columbia. (*Antelope Valley Press*, Mar 5/91)

March 6: NASA engineers studied a tiny crack on the hinge mechanism of Shuttle Atlantis but planned to go ahead with a launch in April. Atlantis was scheduled to ferry into orbit the Gamma Ray Observatory, a Hubble Space Telescope-class astronomical instrument built to study extremely high energy radiation from deep space. (NASA Release, "STS-37 Mission Advisory"; UPI, Mar 6/91)

March 7: An article pointed out that space exploration was not a short-term mission. Therefore, given the age of several existing Space Shuttles, Congress should plan ahead and appropriate funds for additional Shuttles for the 21st century. (*Antelope Valley Press*, Mar 7/91)

- NASA's Earth Observing System faced possible funding cuts as a result of questioning by Representative Ralph Hall, chairman of the House Space Subcommittee, and his colleagues. Concerns exist also within NASA regarding program costs. Tension reportedly existed between NASA Headquarters and Goddard Space Flight Center, Greenbelt, Maryland, over the amount of the data system to be centered at Goddard as opposed to other NASA sites. Some congressional members questioned NASA's accountability and deplored rivalry between NASA and the National Oceanic and Atmospheric Administration. (*Washington Technology*, Mar 7/91)

- Representative Lamar Smith, Republican, Texas, wrote NASA Administrator Richard Truly expressing concern that NASA's Comet rocket program may keep new firms from entering the commercial space industry. Truly's office was preparing a reply. (*Washington Technology*, Mar 7/91)

- Lennard A. Fisk, Associate Administrator, of NASA's Office of Space Science and Applications, testified before the House Science Subcommittee that the redesign of Space Station Freedom had limited the scope of the laboratory, eliminating experiments in astronomy, physics, and earth sciences. (*Washington Technology*, Mar 7/91)

March 8: Scientists of NASA's Magellan Project, together with the U.S. Geological Survey, invited the public to propose names of notable women for the many impact craters and large volcanic vents being discovered on Venus. Names sent to Magellan offices at NASA's Jet Propulsion Laboratory were to

be compiled for the Working Group for Planetary System Nomenclature, a committee of the International Astronomical Union (IAU). The IAU, which makes the final approval, meets only every three years and thus new names cannot be considered until 1994. (NASA Release 91-38; *W Times*, Mar 22/91; *C Trib*, Mar 27/91)

- NASA Administrator Richard H. Truly announced the selection of Ray J. Arnold as Deputy Assistant Administrator for Commercial Programs. He replaced Lawrence F. Herbolsheimer, who became Deputy Assistant Administrator for Policy and Interagency Coordination. (NASA Release 91-39)
- An editorial commended NASA for being more realistic in its revised plans for a Space Station and particularly for decreasing its emphasis on the role of humans in space. (*San Jose Mercury News*, Mar 8/91)

March 10: Joel S. Levine, a senior research scientist in the Atmospheric Sciences Division of NASA's Langley Research Center, commented on NASA's role in researching the contribution of fires to the "greenhouse effect." He indicated that the oil well fires in Kuwait could be the largest single contributor to this effect. However, forest fires and agricultural burning actually provided more carbon dioxide. NASA scientists studying the problem use satellite findings in their analyses. (*Daily Press*, Mar 10/91)

- Rockwell International announced that it would lay off 450 workers assembling the Space Shuttle Endeavour after its delivery to NASA in late April. (*Antelope Valley Press*, Mar 10/91)

March 11: NASA spokeswoman Vera Hirschberg said former American University president Richard Berendzen was working for Booz-Allen and Hamilton in investigating the societal benefits of the Space Exploration Initiative on behalf of NASA. (AP, Mar 11/91)

- Bruce Bunin, manager of Advanced Commercial Programs at Douglas Aircraft Company, stated that McDonnell Douglas Corporation had won a contract for up to \$8 million from NASA's Langley Research Center to conduct system studies on the next-generation commercial supersonic transport. The five-year contract was part of NASA's High Speed Research Program aimed at resolving environmental and economic issues and developing technology for a High Speed Civil Transport (HSCT). The HSCT team was to study atmospheric effects, noise and sonic boom reduction, advanced materials and lightweight structures, supersonic laminar flow control, engine cycles, and airline economics. (PR Newswire, Mar 11/91)
- An interview featured Lawrence Ross, Director of NASA's Lewis Research Center in Cleveland, a 30-year-old facility with 3,000 civil servants. Priorities

at Lewis include research in propulsion, electric power generation, and advanced communications. Ross answered various questions about the Space Station, solar dynamic power systems, nuclear propulsion research, the continuing need for maintenance funds, and the role of Lewis in the National Aerospace Plane program. (*SP News*, 11-17 Mar/91)

- An editorial raised the fairness issue with regard to NASA's anchor tenancy contracts to help the commercial space business. To date, Spacehab, American Mobile Satellite Corporation, and Orbital Sciences Corporation have such contracts. The editorial advocated that other agencies, such as the Department of Justice in the case of mobile services and environmental and ocean agencies in the case of fish research, should reimburse NASA for these costs. (*SP News*, 11-17 Mar/91)

March 12: In their column, Jack Anderson and Dale van Atta commented on the strong efforts of Texas congressmen to have NASA move Space Station Freedom headquarters from Reston, Virginia to Houston. The headquarters were moved from Houston to Reston in 1987. The cost of such a move would be at least \$26 million, and it would probably delay NASA's program at least a year. (*W Post*, Mar 12/91)

- A lengthy article discussed the work of Dr. Allan R. Sandage, a former assistant of Edwin P. Hubble and his heir. Like Hubble, Sandage is an observational cosmologist concerned with investigating the galaxies and the implications of the expanding universe. Using the Carnegie Institution, which has telescopes at Mount Wilson, as his base, he was working on a two-volume atlas of galaxies. (*NY Times*, Mar 12/91)

- Scientists at Los Alamos National Laboratory in New Mexico developed a new technique of "clustering" to speed the analysis of satellite images. The technique was being adapted for use in crop forecasting, land-use studies, pollution monitoring, and mineral and oil prospecting. (*NY Times*, Mar 12/91)

March 14: NASA announced that as a result of the work of its Lewis Research Center, Cleveland, the arcjet thruster technology had been selected for station keeping use on AT&T's Telstar 4 communications satellites. Arcjet systems offer a significant improvement in propellant use over chemical and other electrically augmented thrusters, thus increasing the satellite's on-orbit lifetime or payload mass. (NASA Release 91-40)

- Fairfax County Board Chairman Audrey Moore argued that if NASA's Space Station management facility were moved from its Reston, Virginia headquarters, at least half of its highly skilled workers would quit, delaying the Space Station program for months or years. The questioning about the status of the Reston facility resulted from a congressional order to NASA in 1990

that it overhaul the management structure for the Space Station project. (*W Post*, Mar 14/91)

- Chase Manhattan Bank granted \$64 million five-year financing to Spacehab Inc. Spacehab was building a large pressurized chamber to fit into the storage bay of the Space Shuttle, giving the astronauts or technicians more room to run experiments. Spacehab planned to send its first unit aloft in December 1992. It obtained capital from McDonnell Douglas Space Systems Company, Aeritalia of Italy, which was designing and building most of the module and its thermal controls, and the Mitsubishi Corporation of Japan. (*NY Times*, Mar 14/91)

- Grumman Corporation announced a cut of 110 more employees at its Space Station Program Support Division in Reston, Virginia. The cuts resulted from NASA's decision to reduce the scope of the Space Station project. (*PR Newswire*, Mar 13/91; *W Times*, Mar 14/91; *NY Times*, Mar 14/91)

March 15: Fred Gordon, spacecraft operations manager at NASA's Goddard Space Flight Center, Greenbelt, Maryland, reported that NASA officially had retired the Dynamics Explorer-1 (DE-1) satellite on February 28, 1991, after nine years of collecting scientific data. The decision was based on an evaluation of the costs for DE-1's operations compared to the expected value of the science gained. According to Dr. Robert Hoffman, Project Scientist for the program, the spacecraft's cameras could see an entire Auroral zone, and the quality and quantity of data produced by the two DE spacecraft far exceeded expectations. DE-2 ended operations February 19, 1983. (NASA Release 91-42)

- The Synthesis Group, a White House study group, planned to recommend U.S. development of nuclear-propelled rockets to send manned expeditions to Mars, according to *Aviation Week and Space Tehcnology*. NASA established the group, chaired by retired Air Force General Thomas P. Stafford, an Apollo astronaut, to gather innovative ideas for lunar and Mars exploration. (*AP*, Mar 15/91; *UPI*, Mar 15/91)

- The Space Studies Board of the National Research Council stated that a smaller, simpler new design for NASA's Space Station did not meet the basic research requirements for which it was to be built. This development came as NASA was preparing to solicit Congress for its annual funding and when the European Space Agency and other international partners had accepted NASA's new plan. (*W Post*, Mar 15/91; *AP*, Mar 15/91; *UPI*, Mar 15/91; *B Sun*, Mar 16/91; *NY Times*, Mar 16/91; *C Trib*, Mar 16/91; *LA Times*, Mar 16/91)

- Dr. Lennard A. Fisk, Associate Administrator of NASA's Office of Space Science and Applications, announced that the Space Studies Board has long opposed justifying Space Station Freedom solely on scientific merit. However,

the Board recognizes, and NASA concurs, that "there are national considerations for building a Space Station other than scientific research." Congress and NASA decided to build the Station in an evolutionary way so that ultimately it would meet the principal scientific research requirements intended. The Station represents a significant part of the long-term goals for the civil space program set by the President. NASA was confident that this was the time to proceed. (NASA Editors' Note N91-17)

- Martin Marietta Corporation announced that it was building a \$337 million space robot, technically a Flight Telerobotic Servicer, to be used in constructing Space Station Freedom. The robot was to have artificial computer intelligence and video cameras on each wrist and the top of its body. (*B Sun*, Mar 15/91)

- A tiny crack was found on one of the substitute Shuttle hinges sent from Endeavour to spaceship Discovery. Dr. William Lenoir, head of NASA's space flight program, said the crack was too small to be a cause for concern. (*NY Times*, Mar 15/91; *W Times*, Mar 15/91; *USA Today*, Mar 15/91; *AP*, Mar 15/91; *UPI*, Mar 15/91)

- William Lenoir, NASA's Associate Administrator for Space Flight, said discussion was taking place concerning the possibility of a Soviet cosmonaut flying on a U.S. Shuttle and a U.S. astronaut spending six months on the Russian Space Station Mir. (*UPI*, Mar 15/91)

March 16: NASA rolled the Shuttle Atlantis to a launch pad at Kennedy Space Center in preparation for a scheduled April 6 liftoff. (*W Post*, Mar 16/91; *LA Times*, Mar 16/91)

March 17: Later in the 1990s, NASA will launch the Satellite Test of the Equivalence Principle (STEP) to compare the inertial and gravitational mass of two objects suspended in orbit. The launch relates to an international effort to study gravity and proposals for locating the National Science Foundation's \$211 million Laser Interferometer Gravitational-Wave Observatory. (*W Post*, Mar 17/91)

- Two military contractors, Boeing Helicopters and Bell Helicopter/Textron were test-flying models of the V-22 Osprey for the Marines. Some congressional supporters are promoting the plane for military use as well as civilian flight. The other tilt-technology company, Ishida, based its tilt-wing plane on technology pioneered by LTV Corporation and Canadair from the 1950s through the 1970s. (*C Trib*, Mar 17/91)

March 18: NASA announced that the spacecraft Galileo would execute a trajectory correction maneuver on March 20 to help aim it for the first-ever flyby

of an asteroid next October. To perform the maneuver, Galileo would fire its small thrusters on and off during a three and one half hour period, thus changing its speed about five miles per hour. NASA's Jet Propulsion Laboratory, Pasadena, California, manages the Galileo project. (NASA Release 91-43)

- NASA issued a summary fact sheet on its earth science research programs. Past NASA satellite missions used various remote-sensing instruments to study parts of the Earth system. The Coastal Zone Color Scanner on Nimbus-7 observed the biological productivity of the oceans. The Total Ozone Mapping Spectrometer (TOMS), on the same satellite, returned 12 years of data on global ozone levels and helped identify the Antarctic "ozone hole." In the 1990s, NASA was to study the interaction of all environmental factors air, water, land, and biological life, that make up the Earth system—to help decision-makers understand global environmental trends and protect the planet.

The Upper Atmosphere Research Satellite, to be placed in orbit by the Space Shuttle in the fall of 1991, would make comprehensive measurements of the stratosphere. TOPEX/Poseidon is a U.S.-French ocean-topography satellite to be launched aboard a French Ariane rocket in 1992. It would provide detailed measurements of the oceans' global circulation patterns. Lageos-II, a joint mission with the Italian Space Agency, would provide data on the Earth's geodynamics in 1992. The Earth Observing System (EOS) is a series of satellites carrying various instruments that were scheduled to make simultaneous, global-scale observations of related environmental variables and climate. The EOS Data and Information System were to come on-line in the early 1990s to analyze existing data and provide them to scientists around the world.

EOS data will also be provided by Earth Probes, low-cost missions for small launch vehicles and instruments such as TOMS. In the mid-1990s, the Tropical Rainfall Measuring Mission, a joint mission with Japan, would observe rainfall in Earth's low latitudes. The NASA Scatterometer, to be launched in 1995 aboard the Japanese Earth Observing Satellite, would provide global measurements of sea surface winds.

In addition, Space Shuttle missions provide a unique means for experiments that require multiple flights. A series of at least five international Spacelab missions in the 1990s, designated the Atmospheric Laboratory for Applications and Science, were scheduled to investigate atmospheric science and solar science questions relating to global change. The Shuttle also was to carry the Shuttle Solar Backscatter Ultraviolet experiment. The Space Radar Laboratory was to measure surface geology, vegetation, and ocean circulation.

Mission to Planet Earth is NASA's contribution to the U.S. Global Change Research Program, a multiagency effort. In turn, this program is part of international efforts to study the environment, including the International Biosphere Geosphere Program and the World Climate Change Research Program. (NASA Facts, Mar 18/91)

- NASA's scaled-back design for Space Station Freedom was to be considered at a National Space Council meeting at the White House. The National Space Council members include members of the Cabinet, the director of the Office of Management and Budget, the White House Chief of Staff, the presidential science adviser, the director of the Central Intelligence Agency, and NASA Administrator Richard Truly. (*W Post*, Mar 18/91)
- NASA's Hubble Space Telescope enabled the most detailed images of Mars ever taken. Scientists said the telescope made possible a long-term program to monitor seasonal climate and surface changes on Mars that previously had been impossible. According to the Space Telescope Science Institute in Baltimore, the images revealed Martian features as small as 31 miles across. (*W Post*, Mar 18/91; UPI, Mar 18/91; CSM, Mar 19/91; *Htsvl Tms*, Mar 25/91)
- Launch Box—Your TV Connection to Outer Space, a new 14-episode program, is an educational series created by teachers for classroom use. NASA, Nickelodeon, and the Astronauts Memorial Foundation joined to fund the series, the first segment of which was scheduled to appear on May 9. The series includes footage of actual NASA missions as well as lesson plans for teachers. (*Business Wire*, Mar 18/91)
- An editorial in *Aviation Week and Space Technology* commented on the regeneration of U.S. aerospace technological strengths represented by the National Aerospace Plane (NASP) and NASA's space program. The editorial quoted Assistant Air Force Secretary for Acquisition John J. Welch, Jr. as strongly endorsing the NASP before Congress, calling it "our flagship science and technology program." The editorial commends NASA's downsizing of its Space Station plans, as well as the work of The Synthesis Group in working on a master plan for the Moon/Mars missions. (*AvWk*, Mar 18/91)

March 19: NASA spokeswoman Lisa Malone said three days of torrential rain at Cape Canaveral, Florida, had failed to damage Space Shuttle Atlantis. (*B Sun*, Mar 19/91; *USA Today*, Mar 19/91)

- A report cited efforts of Byron L. Dorgan of North Dakota, chairman of the new Democratic task force on government waste, to point to NASA's "Super Guppy," a large transport plane, as an example of waste to be eliminated. (*W Post*, Mar 19/91)
- After two years of study, the National Research Council in its report, *The Decade of Discovery in Astronomy and Astrophysics*, recommended that more modest instruments than the Hubble Space Telescope and only a few large observatories be developed. The next instrument, the \$617 million Gamma Ray Observatory, was to be launched in April 1991. During the 1990s, of more than 50 proposals made, the report endorsed only four: the \$1.3 billion Space

Infrared Telescope Facility; an \$80 million infrared-optimized telescope on Mauna Kea in Hawaii; the \$115 million Millimeter Array, a group of telescopes to cover star-forming regions and galaxies; and a \$55 million optical telescope to operate in the Southern Hemisphere. The report recommended several more modest programs including the \$230 million Stratospheric Observatory for Far-Infrared Astronomy; the \$250 million Astrometric Interferometry Mission to map positions of celestial bodies more precisely; the \$15 million Large Earth-based Solar Telescope; and a \$70 million spacecraft dedicated to the Far Ultraviolet Spectroscopy Explorer satellite, and increasing to five the Explorer satellites to be launched on rockets. (UPI, Mar 19/91; *W Post*, Mar 20/91; *W Times*, Mar 20/91; *NY Times*, Mar 20/91; *LA Times*, Mar 20/91; *B Sun*, Mar 24/91)

- A dress rehearsal occurred for Atlantis' four-man, one-woman crew in preparation for the blastoff on April 5. Plans for the Columbia were uncertain after a decision to disassemble the space ship's boosters because data indicated a problem with the way the bases of the rockets were bolted to their mobile launch platform. (AP, Mar 19/91; UPI, Mar 20/91)

- Pamela Clark, a former NASA employee who teaches chemistry, wrote an article criticizing the lack of support from upper management of the space program. She urged Congress to adequately finance a civilian space program that would recognize America's position of world leadership. (*H Chron*, Mar 19/91)

March 20: NASA announced that the Aerospace Safety Advisory Panel would present its annual report to NASA Administrator Richard H. Truly on March 22. (NASA editors' note N91-19)

March 21: NASA announced adjustments to the February 1991 Mixed Fleet Manifest as a result of the cracks discovered on Space Shuttle Discovery. Space Shuttle Atlantis was to fly in April; after repairs, Discovery (STS-39 mission) was to fly in May as was STS-40/Spacelab Life Sciences Mission aboard Columbia. The Tracking Data Relay Satellite Mission originally scheduled to fly on Discovery in July was to be on Atlantis in August. The Defense Support Program mission remained on Atlantis but was moved from August to December with the Upper Atmosphere Research Satellite. The International Microgravity Laboratory mission planned for December 1991 would become the first flight in 1992. The mixed cargo flight of the Tethered Satellite System and the European Space Agency's European Retrievable Carrier, originally scheduled for February 1992 on Discovery, would move to August 1992 on Atlantis. Other mid-1992 flights would remain as scheduled earlier. (NASA release 91-44; AP, Mar 21/91; UPI, Mar 21/91)

- NASA announced delivery of its "restructuring" report to Congress, redesigning Space Station Freedom. William B. Lenoir, Associate

Administrator for Space Flight, stated that NASA cut costs (by \$8.9 million through 1999), simplified the design, and reduced the complexity of the project in accordance with Congress's directions and the Augustine Commission's recommendations. Six Shuttle flights would be needed to achieve the human-tended phase when astronauts, brought by the Space Shuttle, work for two-week periods. A permanently manned configuration would be achieved in fiscal year 2000, consisting of the U.S. laboratory and habitat, and European and Japanese laboratories; the Canadian Mobile Servicing System; accommodations for a live-in crew of four; and three sets of solar arrays providing 65 kilowatts of electric power. Before permanent occupancy, an Assured Crew Return Vehicle must be available to evacuate crew in emergency; this phase requires 17 Shuttle flights. Various changes in ground facilities were also planned, scaling back some plans and resulting in some layoffs by contractors and subcontractors. (NASA release 91-45; *B Sun*, Mar 21/91; *W Post*, Mar 21/91; *WSJ*, Mar 21/91; *USA Today*, Mar 21/91; *AP*, Mar 21/91; *UPI*, Mar 21/91; *CSM*, Mar 22/91; *W Post*, Mar 22/91; *B Sun*, Mar 22/91; *NY Times*, Mar 22/91; *W Times*, Mar 22/91; *UPI*, Mar 22/91; *The Citizen*, Mar 24/91)

- Vice President Dan Quayle, head of the White House's National Space Council, told NASA and congressional leaders that the National Research Council's criticism of the redesigned NASA Space Station was "not entirely appropriate." He endorsed the project as advancing U.S. leadership in space. Quayle also alluded to the Mars mission saying "We will 'go-as-we-pay,' but we must go." The "pay as you go" terminology in connection with the Space Station project exasperated NASA Administrator Richard H. Truly. (*NY Times*, Mar 21/91; *LA Times*, Mar 21/91; *AvWk*, Mar 25/91)

- NASA's Marshall Space Flight Center, Huntsville, Alabama, announced the selection of the Smithsonian Astrophysical Observatory, Cambridge, Massachusetts, for the contract to design, develop, and operate a science support center for the space-based Advanced X-ray Astrophysics Facility (AXAF). AXAF was scheduled to be launched in 1998 as the third of NASA's Earth-orbiting Great Observatories. The center is to serve the international scientific community with an observation program for the x-ray telescope and the data it collects. (NASA release 91-46)

- A group advising the U.N.-sponsored Intergovernmental Panel on Climate Change stated that a 10-year delay in taking action to curb global warming would mean little further increase in the level of warming predicted by the end of the 21st century. Michael E. Schlesinger, a climatologist at the University of Illinois at Urbana-Champaign, and Xingjian Jiang authored a study indicating this. Meanwhile, William K. Reilly, Administrator of the Environmental Protection Agency, echoed this stance by saying "It's better to get it right than to act too precipitously." Scientists disagreed on the subject,

and Senator Al Gore strongly opposed the Bush Administration's position. (*NY Times*, Mar 21/97)

- George Rhee, an astronomer at New Mexico State University in Las Cruces, in an article in *Nature*, discussed the observed rate at which space is expanding in all directions, known as the Hubble constant. Rhee stated that new measurement had produced the relatively low value of 50 kilometers per second per megaparsec (3.26 million light-years) for the Hubble constant, agreeing with the estimate of Allan R. Sandage of the Carnegie Institution's observatories in Pasadena, California. (*NY Times*, Mar 21/97)

- The Council on Competitiveness in its report found the United States leading the world or holding its own in 61 of 94 technologies considered crucial to future economic progress, including rocket engines, computer software, biotechnology, and advanced welding techniques. However, it deemed the United States trailing in 33 other fields including laser technology and semiconductor chips. International competition and joint efforts to develop a supersonic plane with a new "hypersonic engine" are discussed. Gordon Adams, director of the Defense Budget Project, commented that although most such research would be global, many U.S. firms still did not see themselves as part of a global industry. (*W Post*, Mar 21/97; *P Inq*, Mar 21/97)

March 22: Major General Jeremiah Pearson III appeared before the House Armed Services research and defense subcommittee to testify on behalf of the value of the V-22 Osprey. He said the plane would have been valuable in the Persian Gulf War in facilitating POW rescues. (*W Times*, Mar 22/97)

- Physicists at Los Alamos National Laboratory discovered that huge parts of the sun's magnetic field break away and are propelled into space by the constantly blowing solar wind. This explains how the Sun's magnetic field remains in balance while new magnetic field lines are formed, according to Los Alamos physicist John Phillips. (*W Times*, Mar 22/91)

- Smithsonian officials scaled back plans for a National Museum of Air and Space annex from \$325 million to \$162 million. The site must be within one hour's drive of Washington and would be used largely to store airplanes. In other testimony, officials said the Space Shuttle Enterprise would not be leased to a Japanese television network. (*W Post*, Mar 22/91)

- The Carnegie Institution of Washington assembled a group of leading scientists to honor the memory of Vannevar Bush, responsible for the creation of the National Science Foundation. The scientists deplored lagging U.S. investment in materials, equipment, and research related to science and the fierce competition among corporations and research groups that led to secrecy. James S. Langer of the Institute for Theoretical Physics of the University of

California called for "a less adversarial" National Science Foundation to restore more of a sense of inquiry and adventure to scientific research. (*NY Times*, Mar 22/91)

- A pressurized laboratory to be used on Space Shuttle Columbia's late May mission was damaged when a technician removed a latch and the module tilted, making a slight tear in the module's insulating thermal blanket. NASA spokesman Mitch Varnes said damage appeared minor and should not delay the mission. (*AP*, Mar 22/91)
- UPI stated that Columbia's launch in late May would be delayed five to 11 days by work to realign the spaceship's twin boosters. (*UPI*, Mar 22/91)
- An independent government panel, the Aerospace Safety Advisory Panel, praised NASA for grounding the Space Shuttle fleet in 1990 to fix fuel leaks and not sacrificing flight safety to meet a demanding launch schedule. (*UPI*, Mar 22/91)
- Hughes Communications Galaxy is suing NASA because it refused to launch Hughes' satellites from the Space Shuttle after the Challenger accident. Edward Frankle, NASA general counsel, said the contract foresaw that Hughes might not get the service for which it signed up. (*B Sun*, Mar 23/91; *AP*, Mar 25/91; *W Times*, Mar 26/91; *W Post*, Mar 26/91; *P Inq*, Mar 26/91; *AP*, Mar 26/91)

March 24: Astronaut Mark Lee said a Space Shuttle flight in Endeavour, scheduled for August 3, 1992, in which his wife Jan Davis would also participate, would be just another work assignment. The media featured them as the first married couple in space. (*AP*, Mar 24/91; *H Post*, Mar 25/91; *LA Times*, Mar 27/91)

- Japan's space agency, the National Aeronautics and Space Development Agency (NASDA), plans to have three NASDA astronauts, including one woman doctor, participate in NASA Space Shuttle flights. (*NY Times*, Mar 24/91)
- An editorial in the *Houston Chronicle* stressed the importance of U.S. space activities, including the fact that "A permanent U.S. Space Station is vital to our future technological development and economic prosperity." (*H Chron*, Mar 24/91)
- The oldest B-52 bomber, which serves as a test-bed aircraft for the NASA Ames-Dryden facility at Edwards Air Force Base, and was built in 1952, may be facing retirement. Difficulties in obtaining spare parts were a major consideration according to Jack Levine, Director of NASA's Flight Projects

Division. NASA would like to substitute a newer B-52, such as the G model delivered in the early 1960s, for which spare parts are readily available. (*Antelope Valley Press*, Mar 24/91)

March 25: An article about the 900 telephone area code cited the use of a 900 number by the National Space Institute in 1982, allowing callers to listen in on conversations between mission control and Space Shuttle crews. (AP, Mar 25/91)

- An editorial in *Space News* emphasized the importance of a U.S. Space Station to continue improving U.S. competitiveness in the aerospace industry. However, it maintained that NASA and the administration must better justify the cost of the scaled-down version. (*SP News*, Mar 25-31/91)

- Cort Durocher, executive director of the American Institute of Aeronautics and Astronautics in Washington and a former combat pilot and space engineer, wrote in the *Houston Chronicle* that while working to minimize risks, space exploration involves occasional failures and possible loss of life. (*H Chron*, Mar 25/91)

- William Paciesas, research professor of Physics at the University of Alabama, Huntsville, is co-investigator of an experiment on NASA's Gamma Ray Observatory to be carried by Space Shuttle Atlantis in April. The Burst and Transient Source Experiment was to study the origins of gamma ray bursts. Gamma rays are at the upper end of the energy spectrum, carrying more energy at higher frequency than visible light, ultraviolet light, or x-rays. (*Huntsvl Tms*, Mar 25/91)

- A Space Exploration Initiative (SEI) Synthesis Group, led by former astronaut and Air Force general Thomas Stafford, was collecting ideas for NASA and the White House concerning exploration of the Moon and Mars. A number of Department of Defense programs relate to SEI, such as the Advanced Launch Development Program to improve propulsion technology; the National Aerospace Plane program to develop a hypersonic research aircraft; radiation-hardened avionics and sensors; advanced structural and thermal protection materials; improved orbital propulsion systems; and laser communications between spacecraft. (*SP News*, Mar 25-31/91)

- A space policy analyst for a major aerospace company in California questioned the lack of activity concerning the Strategic Environmental Research Program (SERP). Senator Sam Nunn, Democrat from Georgia, sponsored the program in 1990 to bring vital data and skills from the Defense and Energy departments to bear on problems of environmental research and global warming. The proposal was to select some classified defense satellite data with potential usefulness in global change research, declassify them, and make

them available to researchers in global warming. Congress authorized \$200 million for SERP in the 1991 Defense Authorization Act, but nothing further was heard. (*SP News*, Mar 25/91)

- The Test Technique Demonstrator program at Langley Research Center, Langley, Virginia, provided hypersonic data on airframe/engine integration applicable to the design of the National Aero-Space Plane (NASP). The program involves an industry consortium, which includes the North American Aviation division of Rockwell International, General Dynamics, and McDonnell Douglas for airframe design, and Pratt & Whitney and Rocketdyne for the propulsion system. C. Larry Edwards, manager, NASP Aerodynamics Technology Program, said the hypersonic testing phase should be completed by 1992. (*AvWk*, Mar 25/91)

March 26: Several prominent scientists said NASA's revised plans skimmed on research equipment, such as a large centrifuge, to study the debilitating effects of weightlessness adequately. Life science research is minimized in the new program. (*NY Times*, Mar 26/91)

- Lieutenant General Donald Cromer, commander of the Air Force Systems Command Space Systems Division, told a Space Expo '91 audience that the next generation of rockets would lift payloads into near-Earth orbit for \$300 a pound instead of the \$3,600 per pound it now costs a Titan IV launch vehicle. Cromer worked with NASA to develop an advanced launch system (ALS). The goal was to develop engines ready for testing in 1995-96 with a first flight by 1999-2000. (*AP*, Mar 26/91)

- NASA broke ground at Cape Canaveral, Florida, on a \$56.2 million facility to prepare pieces of Space Station Freedom. (*AP*, Mar 26/91; *USA Today*, Mar 27/91; *W Times*, Mar 27/91; *UPI*, Mar 27/91; *CSM*, Mar 28/91)

- Two Soviet cosmonauts who were running low on food and water left Space Station Mir in their Soyuz TM-11 capsule and flew to the port of their astrophysics lab, Kvant. Their cargo ship, Progress M-7, had failed twice to dock with Kvant. They linked their capsule with the port when the balky antenna was located. Another attempt will be made to attach Progress to Mir. (*AP*, Mar 26/91; *W Times*, Mar 27/91)

- Marshall Space Flight Center Director Jack Lee told the Huntsville-Madison County Chamber of Commerce that the news media were to blame for NASA's bad image during the preceding year. In discussing Marshall's economic impact on the area, Lee cited increases in its budget, which had risen from \$1.8 billion in 1983 to a requested \$3.6 billion in fiscal 1992. Of this amount, an estimated \$1.08 billion would be spent in Alabama. Moreover,

Marshall civil service and contractor employees represented about 12 percent of the total Huntsville population. (*Hntsv Tms*, Mar 26/91)

March 27: NASA's exhibit at the 39th Paris Air Show, June 13-23, was to feature a full-scale mockup of a Space Station Freedom module. The exhibit would also feature NASA programs Mission to Planet Earth and aeronautics research. (NASA Release 91-47)

- NASA cleared Space Shuttle Atlantis for launch on April 5 and said the mission would include the first U.S. walk in space in five and one half years. The five-member crew was to deploy the 17-ton Gamma Ray Observatory. (AP, Mar 27/91; UPI, Mar 27/91; *P Inq*, Mar 28/91; *USA Today*, Mar 28/91; *W Times*, Mar 28/91; *B Sun*, Mar 28/91; *B Sun*, Mar 31/91)

- A solar flare, a strong release of energy from a small area of the sun, created the most intense geomagnetic storm on Earth since 1989. Such events increase radiation levels near Earth and affect electrical power systems, satellites, space missions, and communications and navigation systems. (UPI, Mar 27/91)

- The European organization EUTELSAT selected the Ariane launch vehicle of Arianespace, Inc. for the fifth telecommunications second generation satellite EUTELSAT II-F5. This satellite is a Spacebus 100 spacecraft developed by Aerospatiale and MBB in Germany, with a payload provided by Alcatel. The satellite would provide full coverage of the European continent, parts of North Africa, and the Middle East. (PR newswire, Mar 27/91)

March 28: A NASA scientist, in a commentary accompanying a paper published in the journal *Nature*, warned against interpreting the breaking apart of the Wordie Ice Shelf in the Antarctic as a foreshadowing of widespread melting of the polar ice cap. He maintained that this was a regional warming trend not observed elsewhere in Antarctica. (UPI, Mar 28/91)

- An editorial criticized expenditures by Congress and the administration on Mission to Planet Earth with its environmental concerns, as opposed to spending larger sums on space exploration. (*W Times*, Mar 28/91)

- An alert ground controller noticed that the Progress-7 cargo module was on a collision course with Soviet Space Station Mir and deflected the module. The two cosmonauts succeeded in docking the module and obtaining the food supplies. (AP, Mar 28/91; *B Sun*, Mar 29/91; *W Post*, Mar 29/91)

- NASA stated that a computer glitch temporarily put the \$1.5 billion Galileo Jupiter probe into an electronic state of hibernation. Galileo is in an elliptical orbit around the sun and was scheduled to orbit Jupiter for two years in 1995. The computer problem caused the spacecraft computers to order the

"safing mode" but no damage was apparent. Engineers said Galileo should be back in full operation by the time of the next computer commands in late April. (UPI, Mar 28/91)

- McDonnell Douglas Space Systems awarded Hercules Aerospace of Magna, Utah, a contract to continue production of graphite epoxy solid rocket motors (GEMS) for the Delta II expendable launch vehicle. (PR newswire, Mar 28/91)

- Don Haley, spokesman for NASA's Ames-Dryden Flight Research Facility at Edwards Air Force Base, announced that Space Shuttle Atlantis, which was scheduled for launch on April 5, should land at Edwards April 10, weather permitting. NASA officials preferred the runway and dry lakebed at Edwards to Kennedy Space Center in Florida, which was adjacent to a swamp. (*Antelope Valley*, Mar 28/91)

March 29: Ellen Stofan, a Magellan scientist at NASA's Jet Propulsion Laboratory, Pasadena, California, said the planet Venus may be venting interior heat through giant hot spots called coronae, a form of volcanism. She indicated that Magellan data had revealed many exciting new aspects of coronae. (NASA Release 91-48)

- NASA Administrator Richard Truly held a press conference during his visit to Marshall Space Flight Center for its Honors Day. Truly commended the work on Space Station design performed at Marshall and defended the Hubble Space Telescope, a Marshall-managed project. Fred Wojtalik, Marshall's manager of the Hubble Space Telescope, was given NASA's Distinguished Service Medal. (*Htsvl Tms*, Mar 29/91)

March 31: Dr. Paul Clark, who formerly engaged in cardiovascular research for NASA, two years ago began organizing The Mandate, a grassroots movement that seeks to collect at least 100 million signatures worldwide to create a World Environmental Court of Justice. Individuals also are asked to act responsibly in an environmental sense. (UPI, Mar 31/91)

April

April: NASA's difficulties in hiring and keeping experienced scientists engineers and the problems of underfunded projects and overworked staff were described. The article stated that NASA "has lost more than half of its GS/GM 13-15 scientists and engineers in the past two years." The retention problem in the senior work force caused turmoil at NASA, which was criticized for its performance and management practices. Efforts at pay reform, it was hoped, would improve staff retention and morale. (*Government Executive*, Apr/91)

- A cover story feature article on Mars dealt at length with NASA and the Bush Administration's plans for a "New Age of Exploration" that was intended to result in the "terraformation" of Mars. Life on Mars was described at length and as was planned launching of the Mars Observer. Various stages of terraformation were discussed, beginning with the first (2030-2080), which is to raise the mean temperature of the planet. The final stage (2150-2170) is conceived as having achieved a breathable medium, when Earth's vast investment would begin to pay off. (*Life*, Apr/91)

April 1: The media discussed the forthcoming launch of Atlantis and the Gamma Ray Observatory (GRO) it will set in orbit. Gamma rays have the highest of all forms of radiation and are born deep inside atomic nuclei. GRO was to canvass the entire sky over a two-year period, scanning the whole sky during the first year and concentrating on the most intriguing objects the second year. GRO was to be controlled by NASA's Goddard Space Flight Center in Greenbelt, Maryland. Scientists from Germany's Max Planck Institute, which supplied GRO's imaging telescope, were to assist. GRO's Oriented Scintillation Spectrometer Experiment was to be the main instrument for examining the material enveloping supernovas to look for gamma rays. University of Washington astronomer George Lake believed GRO would find in the dark matter, strange particles called "wimps" (weakly interacting massive particles) in a Milky Way object called Geminga. The Soviet spacecraft Granat, carrying a French gamma-ray detector, found an object that accretes surrounding matter, generating antimatter that in turn creates gamma rays. (*P Inq*, Apr 1/91; *W Post*, Apr 1/91; *AP*, Apr 1/91; *UPI*, Apr 1/91; *NY Times*, Apr 2/91; *USA Today*, Apr 2/91; *W Times*, Apr 2/91; *UPI*, Apr 2/91; *CSM*, Apr 3/91; *W Post*, Apr 3/91; *USA Today*, Apr 3/91; *UPI*, Apr 3/91; *AP*, Apr 3/91; *C Trib*, Apr 3/91; *UPI*, Apr 4/91; *P Inq*, Apr 5/91)

- A NASA crew hauled the Shuttle Discovery to its launch pad to prepare for takeoff approximately April 25. (*UPI*, Apr 1/91; *AP*, Apr 1/91; *W Times*, Apr 2/91)
- An experimental rocket motor being tested for the Air Force Titan IV rocket exploded at Edwards Air Force Base in California. No one was injured in

the explosion. The Titan IV, the largest unmanned rocket in the U.S. fleet, was scheduled to replace NASA's manned Shuttle in flying photo reconnaissance spy satellites and other heavy military payloads. (UPI, Apr 1/91; *W Post*, Apr 2/91; *W Times*, Apr 2/91; *USA Today*, Apr 2/91; *NY Times*, Apr 2/91; *C Trin*, Apr 3/91)

- The Soviet Union launched a large new space satellite, Almaz-1, using a giant Proton booster rocket. Tass said Almaz-1 was launched from the Baikonur cosmodrome in Central Asia. The radar satellite would survey the territory of the Soviet Union and other countries "in the interest of geology, cartography, ecology, and agriculture." The Almaz-1 was the first Soviet satellite to provide commercial services for the American market under long-term contracts. One of its principal customers was to be the U.S. Defense Mapping Agency; other enterprises include oil companies that need detailed images of the Earth. (UPI, Apr 1/91; AP, Apr 1/91; *LA Times*, Apr 2/91)

- News editor Budd McLaughlin of the *Huntsville News* denied the blame placed on the media by Jack Lee, Director of the Marshall Space Flight Center, for NASA's poor public image. (*Huntsville News*, Apr 1/91)

- NASA's Goddard Space Flight Center was testing a beta version of Com's newest OSI routing software. The software was comparable to that known as Open Shortest Path First, which allows intermediate systems to talk to each other and figure out the best way to send information on the network from point A to point B. (*Government Computer News*, Apr 1/91)

- The newspaper summarized the controversy over the revised NASA plans for Space Station Freedom between NASA and the National Research Council, which maintained that the scaling back had gone too far to be valuable. (*San Jose Mercury News*, Apr 2/91)

April 2: Grumman Corporation announced it would eliminate 1,900 jobs by the end of 1991. The major cause was reduced U.S. government defense spending, which included reductions in NASA's budget, leading to a scaling down of Grumman's Space Station Support Division. (AP, Apr 2/91)

- The Synthesis Group, an advisory panel headed by former astronaut Thomas P. Stafford, outlined ways to create a lunar base and make the 35-million-mile trip to Mars. The group's report was expected in May, and John E. Pike, space policy expert for the Federation of American Scientists, said it was expected to recommend that the best method for the flight would be a nuclear reactor-powered rocket. Nuclear power would cut the time of the trip in half from the 450-500 days needed using conventional chemical rockets. It would require convincing the public of the safety and desirability of such nuclear power, which to date has been used only to produce electrical power for long,

unoccupied trips such as that of Voyager that photographed the outer planets. (*Plain Dealer*, Apr 2/91)

April 3: Daniel S. Greenberg, editor of *Science and Government Report*, a Washington newsletter, questioned the redesigned Space Station and expenditures to date on the Station, citing the views of the Space Studies Board of the National Academy of Sciences. (*P Inq*, Apr 3/91)

- The Pentagon was developing secretly a nuclear-powered rocket for boosting heavy military payloads into space as part of the Strategic Defense Initiative, known as "star wars." The program was disclosed by the Federation of American Scientists and was confirmed by government documents obtained by the *New York Times*. NASA reportedly was evaluating the program quietly. The Federation opposed the program because of the risk of radiation release. (*B Sun*, Apr 3/91; *W Post*, Apr 3/91; UPI, Apr 3/91; *WSJ*, Apr 3/91; *W Times*, Apr 4/91)

- Johns Hopkins University in Baltimore announced that for financial reasons it was ending its participation in the Magellan Telescope project in Las Campanas, Chile as of June 30. It cited an inability to raise the \$15 million, which was its project share. The role of the Astronomy Department at Johns Hopkins was enhanced through its space participation. The Hopkins Ultraviolet Telescope was successfully flown aboard the Space Shuttle and Johns Hopkins contains on campus the Space Telescope Science Institute, NASA's center for astronomy programs with the Hubble Space Telescope. (*B Sun*, Apr 3/91)

- Researchers at the National Oceanic and Atmospheric Administration found that the atmospheric lifetime of methane, a key "greenhouse gas," is about 25 percent longer than previously thought. The gas is short-lived compared to other greenhouse gases such as carbon dioxide and chlorofluorocarbons so reductions in methane would ease the greenhouse effect. (UPI, Apr 3/91)

April 4: Navy Commander Ken Reightler, a Marylander, is scheduled to fly on September 19 on the Shuttle Discovery. A Naval Academy graduate and a test pilot, Reightler will be a pilot on the five-day mission that will deploy the Upper Atmosphere Research Satellite. (*B Sun*, Apr 4/91)

- NASA's goal was to deploy two Space Shuttle missions during April: Atlantis on April 5 and Discovery on April 25. The last two-launch month was January 1986. In addition to launching the Gamma Ray Observatory, the Atlantis flight would feature a spacewalk by Jerry Ross and Jay Apt. (*NY Times*, Apr 4/91; UPI, Apr 4/91; *LA Times*, Apr 4/91; *B Sun*, Apr 5/91; *W Post*, Apr 5/91; *NY Times*, Apr 5/91; *W Times*, Apr 5/91; *USA Today*, Apr 5/91; UPI, Apr 5/91; AP, Apr 5/91)

- Magellan project manager Tony Spear at NASA's Jet Propulsion Laboratory, Pasadena, California, announced that the spacecraft had completed its objective for the primary phase of the Venus mission more than one month before the end of the first 243-day mapping cycle. Magellan mapped 70 percent of the planet by April 3, and will have mapped 84 percent by May 15. The mission was to be extended to allow Magellan to map the remaining 14 percent, including the south pole. Toward the latter part of its mission it will also acquire gravity data. Magellan's findings, as described in *Science* magazine, indicated Venus was volcanic and geologically active. (NASA Release 91-49; AP, Apr 4/91; UPI, Apr 4/91; AP, Apr 5/91; NASA Release 91-53)

- NASA announced that its newest Space Shuttle, Endeavour, would be rolled out April 25 at a ceremony at Rockwell International's Space Division Facility, Palmdale, California. (NASA Editor's Note N-91-25)

April 5: NASA satellite observations indicated that Earth's protective ozone layer was thinning twice as fast as believed previously. The Environmental Protection Agency made the announcement. Richard S. Stolarski, a research scientist at the Goddard Space Flight Center, found a four to five percent average decrease over the 11-year period he studied. During the winter, the depletion was eight to nine percent of the layer. Several scientists have stressed the importance of the public developing "good sun habits" in relation to the ozone depletion and reducing the use of chlorofluorocarbons (CFCs). (B Sun, Apr 5/91; NY Times, Apr 5/91; WSJ, Apr 5/91; W Post, Apr 5/91; USA Today, Apr 5/91; W Times, Apr 5/91; LA Times, Apr 5/91; UPI, Apr 5/91; NY Times, Apr 9/91; CSM, Apr 9/91)

- Brief biographies of each Atlantis astronaut appeared . (UPI, Apr 5/91)

- NASA's Goddard Space Flight Center, Greenbelt, Maryland, has selected Hughes/Santa Barbara Research Center, Goleta, California as its contractor for the Moderate Resolution Imaging Spectrometer-Nadir (MODIS-N) instrument for the Earth Observing System (EOS) program. EOS is central to NASA's Mission to Planet Earth Program. MODIS-N is the key research instrument to fly on a series of EOS unmanned polar spacecraft. Over a 15-year period, it would measure terrestrial, oceanographic, and atmospheric parameters to assess environmental changes. (NASA Release C91-1)

- NASA Administrator Richard H. Truly announced that, based on a recent policy review, NASA's Space Flight Participant Program would be kept in abeyance until 1992. NASA previously had indicated that when the program resumed, first priority would be given to a teacher in space in fulfillment of space education plans. (NASA Release 91-50; UPI, Apr 5/91; LA Times, Apr 6/91)

- Royce Mitchell, NASA's Advanced Motor Project Manager at Marshall Space Flight Center, Huntsville, Alabama, announced that NASA would begin a series of sub-scale test firings to evaluate materials intended for use in the new Space Shuttle Advanced Solid Rocket Motor. The first of five nozzle tests would occur on April 10, conducted by Aerojet Corporation, ASRM Division in Iuka, Mississippi. (NASA Release 91-51)

April 5: Astronaut Manley Lanier "Sonny" Carter, who flew on the Shuttle Discovery in 1989, was one of those killed in the crash of the commuter plane carrying former Senator John Tower. Biographic data were given. (UPI, Apr 5/91; AP, Apr 5/91; AP, Apr 6/91; *NY Times*, Apr 6/91; *W Post*, Apr 6/91)

- Thousands of people watched Atlantis take off from Cape Canaveral, Florida. The external fuel tank from Space Shuttle Atlantis broke off after takeoff and was seen over Hawaii streaking toward Earth. Some accounts gave biographic data of crew members. (AP, Apr 5/91; *W Post*, Apr 6/91; *LA Times*, Apr 6/91; *NY Times*, Apr 6/91; *P Inq*, Apr 6/91; *B Sun*, Apr 6/91; *LA Times*, Apr 7/91)

April 6: The crew of Atlantis talked with American schoolchildren while in orbit over the United States. (AP, Apr 6/91; *W Post*, Apr 7/91; *B Sun*, Apr 7/91; *NY Times*, Apr 7/91)

April 7: The crew of Atlantis photographed the oil well fires burning in Kuwait as they passed over. (UPI, Apr 7/91)

- The *Orlando Sentinel Star* published two special reports on NASA and Space Shuttles. The first was a review of the first 10 years of space flight: the dreams in contrast with the reality of costs and delays experienced. The conclusion was that "The price of a rushed design on a shoestring budget has meant, for the Shuttle, unreliability." The second article dealt with NASA's plans for the next decade with reference to such items as the Personnel Launch System, a small capsule or space plane on top of an expendable booster rocket to carry astronauts and some cargo to a Space Station; the Advanced Manned Launch System, a reusable vehicle combined with a reusable booster, capable of carrying more persons and cargo; and the National Aerospace Plane (NASP), which would burn a "slush" mixture of liquid and solid hydrogen. Most research funds to date went into the development of the NASP. (*O Sen Star*, Apr 7/91)

April 8: Jerry Ross and Jay Apt fixed a stuck satellite antenna in NASA's first unscheduled repair in space, showing the value of the human element in space flight. Thereafter they remained outside for three more hours to test equipment. A further spacewalk was scheduled before return to Earth. (*USA Today*, Apr 8/91; *B Sun*, Apr 8/91; AP, Apr 8/91; UPI, Apr 8/91; *C Trib*, Apr 8/91;

CSM, Apr 9/91; *W Post*, Apr 9/91; *Birmingham Post-Herald*, Apr 9/91; *Birmingham News*, Apr 12/91)

- Chairman Leon Panetta, Democrat from California, of the House Budget Committee, proposed to cut President Bush's requested increase for space spending from 12 percent to 4.2 percent over the present level—enough to keep pace with inflation. (UPI, Apr 8/91)
- Ham radio operators in Long Beach, California, made history when they successfully transmitted a television picture to the Space Shuttle Atlantis. (*LA Times*, Apr 8/91)
- The General Services Administration (GSA) and NASA were at odds over the timing and method of moving NASA's main voice and data network to the mandatory FTS 2000 contract. GSA was pressuring NASA to move all of its Program Support Communications Network (PSCN) to FTS 2000 by September 30. PSCN provides long distance communications between NASA centers and its contractors and NASA planned to move to FTS 2000 over a two-year period. Details of services to be provided remained to be worked out. (*Federal Computer Week*, Apr 8/91)

April 9: Ross and Apt made a second spacewalk, this one of six hours, testing a cart running on a monorail along one side of the Shuttle's cargo bay. They also tested different manual, mechanical, and electrical systems for moving safely and efficiently in weightlessness. (*LA Times*, Apr 9/91; *B Sun*, Apr 9/91; *W Post*, Apr 9/91; *NY Times*, Apr 9/91; *W Times*, Apr 9/91; *USA Today*, Apr 9/91; *P Inq*, Apr 9/91; AP, Apr 9/91; UPI, Apr 9/91)

- Astronomers Joss Bland-Hawthorn of Rice University, Andrew S. Wilson of the University of Maryland, and R. Brent Tully of the University of Hawaii, using the telescope atop Mauna Kea volcano in Hawaii have found a huge object. It might be a "supermassive black hole," but if so it would be more than 100 million times larger than the largest black hole thought to exist. It might also be a dead or dormant quasar. Astronomers hoped that the Gamma Ray Observatory of Atlantis would help to resolve the mystery. (*NY Times*, Apr 9/91; AP, Apr 9/91; *P Inq*, Apr 10/91; *W Post*, Apr 10/91; *USA Today*, Apr 10/91; UPI, Apr 10/91; *LA Times*, Apr 15/91)

- Former astronaut Michael Collins in his new book, *Mission to Mars*, said that he believed homosexuals should be barred from space exploration because they would be likely to create interpersonal problems. NASA never considered sexual orientation in hiring. (AP, Apr 9/91; *Long Beach Press Telegram*, Apr 9/91)

- Peenemunde, Germany was the place where the first self-propelled rocket left the Earth's atmosphere. This occurred on October 3, 1942 when the Nazis

launched a 5 1/2 ton V-2 rocket to a height of more than 50 miles. A museum was scheduled to open on the site. (*LA Times*, Apr 9/91)

April 10: Atlantis made six passes by Soviet Space Station Mir as it prepared to land. The astronauts finished experiments and tested a manual system for chasing down targets in orbit. (*P Inq*, Apr 10/91; *W Times*, Apr 10/91; *B Sun*, Apr 10/91; *USA Today*, Apr 10/91; *NY Times*, Apr 10/91; *LA Times*, Apr 10/91; *C Trib*, Apr 10/91; *AP*, Apr 10/91; *UPI*, Apr 10/91)

- NASA announced the naming of astronaut Colonel Guy S. Gardner as Commandant of the U.S.A.F Test Pilot School at Edwards Air Force Base, California. He was to leave the astronaut corps in June 1991 to assume his new post, which is part of the Air Force Systems Command. (NASA Release 91-52)

April 11: NASA postponed the landing of Space Shuttle Atlantis because of high winds at Edwards Air Force Base in California and bad weather at the alternate landing site of Kennedy Space Center in Florida. (*P Inq*, Apr 11/91; *B Sun*, Apr 11/91; *W Post*, Apr 11/91; *W Times*, Apr 11/91; *NY Times*, Apr 11/91; *USA Today*, Apr 11/91; *AP*, Apr 11/91; *UPI*, Apr 11/91)

- A panel on global warming of the National Academy of Sciences urged the Bush administration to take various anti-pollution and energy efficiency steps to slow global warming. The study was initiated in 1988 when Congress asked the Environmental Protection Agency to commission the academy to study the subject and recommend actions. The panel's central concern was to reduce greenhouse gas emissions, especially the "aggressive phase-out" of chlorofluorocarbons in accordance with the timetable in the 1990 London Protocol. It also recommended energy conservation measures and increased research into alternative energy supplies as well as new-generation nuclear reactors. (*B Sun*, Apr 11/91; *P Inq*, Apr 11/91; *W Post*, Apr 11/91; *USA Today*, Apr 11/91; *NY Times*, Apr 11/91; *LA Times*, Apr 11/91)

- The Hubble Space Telescope proved more useful than expected despite the flaw in its mirror. The congressional appropriation of an additional \$30 million in NASA's 1991 budget allowed some repairs to be made from the ground using computer processing and radio control. NASA plans additional repairs by astronauts in 1993, attaching new mirrors to the outside of the telescope. (*W Times*, Apr 11/91)

- NASA revised its Space Station plan to include a centrifuge. The absence of a centrifuge in the scaled-down plan was criticized by a number of scientists, who considered it essential for the study of the effects of weightlessness. (*NY Times*, Apr 11/91)

- The Soviet Union used the name of Yuri Gagarin, the first human in space 30 years ago, to boost its emerging commercial space program. President Mikhail S. Gorbachev at an opening ceremony in Moscow said Soviet space science and technology were open to international cooperation and called for joint space research with the United States, European countries, China, India, Japan, and others. (AP, Apr 11/91)

- Four Israeli high school students paid a two-week visit to the United States after winning an astrophysics contest in Israel. The competition was sponsored by the National Museum of Science, Planning, and Technology in Haifa to encourage Israeli youth to focus on technology and the sciences. The students visited Goddard Space Flight Center in Greenbelt, Maryland and NASA's headquarters. (*Washington Jewish Week*, Apr 11/91)

April 12: Atlantis landed safely at Edwards Air Force Base, California, one day late. It was to be flown to Cape Canaveral atop a modified Boeing 747. The astronauts appeared in excellent condition. (*P Inq*, Apr 12/91; *B Sun*, Apr 12/91; *W Times*, Apr 12/91; *USA Today*, Apr 12/91; *NY Times*, Apr 12/91; *WSJ*, Apr 12/91; *W Post*, Apr 12/91; *LA Times*, Apr 12/91; AP, Apr 12/91; UPI, Apr 12/91)

- General Thomas S. Moorman, Jr., commander of Air Force Space Command at Peterson Air Force Base in Colorado, said orbiting satellites were integral to mid-air and ground operations in the Persian Gulf War. He spoke at a conference at Tufts University on "The United States Air Force: Aerospace Challenges and Missions in the 1990s." (CSM, Apr 12/91)

- The Soviet Union observed Cosmonaut Day, marking the thirtieth anniversary of the space flight of Yuri Gagarin. (*P Inq*, Apr 12/91; *USA Today*, Apr 12/91; AP, Apr 12/91)

- Orbital Sciences Corporation in Fairfax, Virginia, made a reputation for fast, frugal flights into space that won it a number of contracts with NASA and the Air Force. It developed the Pegasus rocket, which was launched from under the wing of a B-52 in 1990. Since then it has developed various other rockets designed to boost Shuttle payloads. (*W Times*, Apr 12/91)

- An article on interactive computer graphics and the virtual reality system they involve stated that NASA's Visualization for Planetary Exploration project might use such technology. It would enable the creation of environments of the moon and planets that would use data gathered by space probes and satellites to allow users to feel they were visiting those bodies. (*W Times*, Apr 12/91)

- Final approval was given for the construction of a new visitors' center at the Johnson Space Center, Houston. The Manned Space Flight Education Foundation helped raise funds for the \$60 million structure. (AP, Apr 12/91)

- *Aviation Week and Space Technology* reported that a Soviet spacecraft carrying supplies for the two cosmonauts aboard the Mir Space Station almost collided with the station during a docking attempt. (AP, Apr 12/91; C Trib, Apr 14/91)
- The Marshall Islands commemorated the tenth anniversary of U.S. Space Shuttle flights by issuing a block of four stamps. (AP, Apr 12/91)
- An editorial commended the Space Shuttle record as remarkably positive over the past 10 years. (*Fla Today*, Apr 12/91)

April 13: A \$40 million communications satellite was launched by a Delta rocket from Cape Canaveral Air Force Station, Florida. The satellite was owned by GTE Spacenet Corporation of McLean, Virginia. The satellite was scheduled to take over the work of the present Westar spacecraft in June and increase GTE's transponder capacity for relaying information. (AP, Apr 13/91; UPI, Apr 13/91; CSM, Apr 15/91)

- The Los Angeles Air Force Base at El Segundo was omitted from the list of proposed base closings of the Department of Defense. The base houses the Air Force Space Systems Division, a 3,200-employee unit that oversees military contracts for procurement of space hardware. (*LA Times*, Apr 13/91)
- The two astronauts on NASA's first Shuttle flight 10 years ago, John Young and Robert Crippen, returned to Cape Canaveral for an anniversary celebration. The 20,000 workers at Kennedy Space Center and their families were invited for the occasion. (AP, Apr 13/91; B Sun, Apr 14/91)
- NASA engineers worried over data indicating that the critical 16-foot main antenna of Galileo, essential for the Jupiter probe, may have failed to unfold properly. Such a failure would limit the speed of transmitting data from Jupiter to Earth and reduce the number of photographs that could be sent. Galileo was unique among spacecraft launched to date in that it has a "dual spin" design with the antenna being located on the spinning section. Efforts were underway to see how the situation could be remedied. (*LA Times*, Apr 13/91; UPI, Apr 13/91; AP, Apr 13/91; UPI, Apr 15/91; *NY Times*, Apr 17/91; B Sun, Apr 18/91; *W Times*, Apr 18/91; *USA Today*, Apr 18/91)
- An internal memorandum signed by four NASA officials as well as interviews with staff at the Reston, Virginia, facility indicated a strong opinion that moving the headquarters now would disrupt development of the \$30 billion Space Station. At a recent meeting three-quarters of NASA staff were said to oppose a move. Despite this fact, NASA Assistant Administrator William B. Lenoir was said to have decided to recommend moving the headquarters. (*H Chron*, Apr 13/91)

April 15: Following the Flight Readiness Review, NASA announced April 23 as the launch date for Space Shuttle Discovery, with a seven-man crew commanded by Navy Captain Michael L. Coats. (NASA Release 91-54; *W Times*, Apr 16/91; AP, Apr 16/91; UPI, Apr 16/91; *B Sun*, Apr 17/91; *NY Times*, Apr 18/91)

- Edward Stone, new Director of the California Institute of Technology's Jet Propulsion Laboratory (JPL), which manages planetary missions for NASA, commented on present and future plans. He stated Magellan was sending back pictures of Venus; Galileo, on its way to explore Jupiter and its moons, would view the asteroid Gaspra in October; and Mars Observer was being prepared for a September 1992 launch. He spoke of the preliminary unmanned research necessary before any exploration of Mars could be undertaken. (CSM, Apr 15/91)

- Astronomer Vera Cooper Rubin discussed dark matter in the universe in the first of a six-part public television series, "The Astronomers." Rubin, a scientist at the Carnegie Institution for the past 26 years, concentrated on the study of dark matter, which is thought to account for the mass of nine-tenths of matter in the universe. (*W Post*, Apr 15/91; *NY Times*, Apr 15/91)

- NASA and the Defense Department were expected to present the National Space Council with a proposal to build a new, heavy unmanned booster for the late 1990s. It would be based on a Space Shuttle external tank equipped with oxygen/hydrogen engines, using strap-on solid rocket motors. Jack Lee, Director of the NASA Marshall Space Flight Center, told the U.S. Space Foundation Symposium in Colorado Springs that the belief was that the new device could achieve a payload cost to orbit as low as \$500-\$1,000 per pound. (*AvWk*, Apr 15/91)

- The House Government Operations Committee asked NASA to reinstate the third bidder, Convex Computer Corporation, for the Operations Automatic Data Processing contract. Convex was disqualified for filing its bid nine minutes late. The request was made, according to committee chairman John Conyers, Democrat from Michigan, in order to encourage competition. (*Federal Computer Week*, Apr 15/91; *Government Computer News*, Apr 15/91))

- Construction of NASA's Ames-Dryden Integrated Test Facility at Edwards Air Force Base was 18 months behind schedule and \$3.1 million over its original cost estimate because three successive contractors pulled out of the job, NASA said. Efforts were underway to find a new contractor. NASA spokesman Don Haley asserted that the construction delays had not hindered aircraft tests. (*Los Angeles Daily News*, Apr 15/91; *Californian*, Apr 19/91)

April 16: NASA's Aerospace Safety Advisory Panel, an independent group of industry and academic experts, was pressuring NASA to consider automated

landings that would minimize the need for humans and increase the safety factor. (*NY Times*, Apr 16/91)

- Orbital Sciences Corporation of Fairfax, Virginia, launched its first Firebird suborbital vehicle from a NASA flight center in Wallops Island, Virginia. The launch was conducted under contract to the Massachusetts Institute of Technology's Lincoln Laboratory in support of the Strategic Defense Initiative Organization. The Firebird deployed ballistic missile reentry targets that were used in tracking experiments conducted on the ground. (*W Times*, Apr 16/91)

- NASA requested proposals to establish six Regional Technology Transfer Centers (RTTC), each funded at about \$1 million annually. These would replace 10 Industrial Applications Centers, whose contracts expire in 1991. The restructuring was intended to broaden geographical coverage to include all contiguous states by establishing a regional structure similar to the six Federal Laboratory Consortia for Technology Transfer. The intent also was to establish close ties with NASA's Centers for the Commercial Development of Space in various regions and to encourage partnerships with universities and state organizations as well as promote local businesses. (NASA Release 91-55)

- Sherwood Rowland, a scientist from the University of California-Irvine, told Congress that winter ozone depletion over the northern United States and Canada was about one-third greater than the already alarming declines detailed in new NASA studies. Rowland in 1974 was one of the first to warn of the dangers of ozone-depleting industrial compounds like chlorofluorocarbons. (UPI, Apr 16/91)

- Atlantis began its piggyback jet ride to Florida atop its Boeing 747. (AP, Apr 16/91)

April 17: While commending Jay Apt's and Jerry Ross's work in freeing the jammed antenna of the Gamma Ray Observatory during their Atlantis mission, an editorial commentator advocated a rethinking of spaceflight goals and greater realism. (CSM, Apr 17/91)

- Senator Albert Gore, Democrat from Tennessee, chairman of the Senate Commerce subcommittee on Commerce, Space, and Transportation, questioned the cost figures in NASA's revised Space Station plans. William Lenoir, head of NASA's space flight, conceded that the \$30 billion cost did not include such items as \$1.5 billion to \$2 billion to build an emergency crew return vehicle. The Space Studies Board of the National Research Council told the Senate subcommittee that it supported its earlier March statement about spending Space Station funds differently. (*W Times*, Apr 17/91; UPI,

Apr 17/91; AP, Apr 17/91; *Washington Technology*, Apr 18/91; AP, Apr 19/91; *Htsvl Tms*, Apr 19/91)

- Stormy weather prevented Space Shuttle Atlantis from landing at Kennedy Space Center. It landed instead at MacDill Air Force Base; the flight would resume when the weather cleared. (AP, Apr 17/91; UPI, Apr 17/91)

- The Sunnyvale, California City Council approved a position paper prepared by the Moffett Field Committee, composed of representatives of NASA's Ames Research Center, and several neighboring city councils and chambers of commerce. The paper proposed that, if Congress approved closing the Moffett Field Naval Air Station, NASA operate the field instead to ensure that research and transport activities continue. (*San Jose Mercury News*, Apr 17/91; *San Jose Mercury News*, Apr 18/91)

April 18: The House of Representatives rejected President Bush's proposed budget, allowing only a 4.2 percent increase in the space program to keep pace with inflation, instead of the recommended 12 percent increase. (UPI, Apr 18/91; *B Sun*, Apr 18/91)

- NASA announced that its Ames Research Center at Moffett Field, California, and Terra-Mar Resource Information Services, Inc., of Mountain View, California, would jointly develop a system to allow firefighters to merge elevation and vegetation data with live pictures of forest fires. This would enable firefighters quickly to "see" through a smoky forest fire and plan their strategy. The three-year, \$600,000 project called for NASA to expand existing remote sensing technology and for Terra-Mar to develop portable computer work stations and advanced software. (NASA Release 91-56)

- The NASA Lewis Research Center, Cleveland, awarded a \$112 million contract to General Dynamics Commercial Launch Services, Inc. in San Diego, California, for launch services connected with the Solar and Heliospheric Observatory (SOHO). SOHO is part of a cooperative effort among NASA, the European Space Agency, and the Japanese Institute of Space and Astronautical Science to conduct an examination of the Sun and various solar phenomena for launches in 1992 through 1995. (NASA Release C91-m)

- Atlantis returned to Kennedy Space Center from MacDill Air Force Base in Tampa. (AP, Apr 18/91)

- NASA selected Ball Corporation of Muncie, Indiana, to repair the Hubble Space Telescope. (*C Trib*, Apr 18/91)

- Business, county, and NASA officials met in Reston, Virginia, to announce a new hotline for anyone who wanted to keep the NASA Space Station Program in Reston. The Coalition for Space Station Continuity set up the hotline, following reports that the Texas Congressional delegation urged that NASA move to Houston. (*McLean/Great Falls Connection*, Apr 18/91)

- A study by the University of Southern California found that space exploration was viewed as “frivolous” by the average American. These results were disclosed at the 7th annual National Space Symposium. A space journal commented that NASA needed to find new ways of communicating its message more effectively. (*Washington Technology*, Apr 18/91; *AvWk*, Apr 29-May 5/91)

April 19: The upper stage of a commercial Atlas rocket made by General Dynamics Corporation carrying a satellite for the Japan Broadcasting Corporation failed after liftoff from Cape Canaveral. Ron Maehl of General Electric Aerospace Group, which made the satellite, refused to state the cost for the spacecraft and the launch, saying only that the rocket cost slightly more than the satellite. The accident was described as a major setback for General Dynamics whose Atlas program lost \$300 million in 1990. Details of the stages of the Atlas-Centaur rocket and its intended use to replace the satellite destroyed in the explosion of a European Ariane rocket in February 1990 were given. (*NY Times*, Apr 19/91; *B Sun*, Apr 19/91; *WSJ*, Apr 19/91; *UPI*, Apr 19/91; *AP*, Apr 19/91; *NY Times*, Apr 20/91; *W Post*, Apr 20/91; *P Inq*, Apr 20/91)

- NASA announced crew assignments for the International Microgravity flight, scheduled for February 1992 and the Spacelab D-2 mission, the second German Spacelab flight, scheduled for February 1993. Lt. Col. David C. Hilmers was to be mission specialist on the microgravity flight and Lt. Col. Jerry L. Ross was to serve as Payload Commander on the spacelab flight. (NASA Release 91-57)

- NASA solicited proposals for establishing additional Centers for the Commercial Development of Space (CCDS). These centers were to specialize in the commercialization of advanced satellite communications technologies and other space-based telecommunications technologies. NASA’s current CCDS specialize as follows: materials processing, 5; life sciences, 3; remote sensing, 2; automation and robotics, 2; space propulsion, 1; space structures and materials, 1; and space power, 2. (NASA Release 91-58)

- NASA announced that it was conducting intensive analysis of the problem that prevented deployment of the Galileo spacecraft’s high-gain antenna. Even if the antenna is only partially deployed, the planned flyby of the asteroid Gaspra on October 29 would take place. (NASA Release 91-59)

- The subcommittee of NASA’s Office of Astronautics and Exploration Technology said the redesign of the Space Station would still enable all pro-

posed experiments to be handled. However, two major experiments might not be able to be conducted simultaneously because of power limitations. (*Htsul Tms*, Apr 19/91)

April 20: NASA prepared to begin countdown for Shuttle Discovery, despite predicted bad weather. (*P Inq*, Apr 20/91; *W Post*, Apr 21/91; *B Sun*, Apr 21/91; *USA Today*, Apr 22/91; *W Post*, Apr 22/91; *AP*, Apr 22/91; *UPI*, Apr 22/91)

April 21: The *New York Times* featured a lengthy article on robots that might be used in Martian exploration as well as in industrial activities. The designer of the principal robot under consideration was William L. Whittaker, a Carnegie-Mellon University professor. He demonstrated to government officials the Ambler, a 19-foot tall, six-legged robot that could step over high boulders and avoid holes. Named Attila, the robot has 25 motors and 150 sensors and develops its behavior from the interaction of dozens of independent processors. The robot represents a combination of electrical and mechanical engineering and computer science. In addition, Whittaker demonstrated a computer and laser vision system that could steer a vehicle in a straight line. (*NY Times*, Apr 21/91)

- Co-workers at Rockwell International organized a farewell party for some 400 workers, who would be laid off when Shuttle Endeavour rolls out. (*Los Angeles Daily News*, Apr 21/91)

- A columnist compared NASA's cutting the plans and cost for the Space Station at congressional request with proposed programs of the Strategic Defense Initiative (SDI). Whereas NASA cut its projections, to the point that some questioned the viability of the result, SDI appeared to have an undiminished appetite for funds. (*LA Times*, Apr 21/91)

- John W. "Jack" Russell, a crack aviation mechanic and retired NASA employee, was scheduled to be the first member of the aviation support sector to be enshrined in the Amherst Museum's Niagara Frontier Aviation Hall of Fame. (*Antelope Valley Press*, Apr 21/91)

April 22: The Defense Department lifted military secrecy from Shuttle missions, not because of decreased Soviet threat or the nature of the payload but because of the cost of security. The move was expected to save the government \$80 million. Security would be applied more selectively because the Soviet Union and the American public were considered to be familiar with the nature of most space flights to date. Discovery would carry a payload known as Cirris, for Cryogenic Infrared Radiation Instrumentation for Shuttle, designed to determine the feasibility of the space-based detection of enemy aircraft and missiles. (*NY Times*, Apr 22/91; *P Inq*, Apr 23/91)

- A Soviet commentator castigated the United States for its refusal to return to Moscow a display model of a spacecraft nuclear reactor Topaz 2 brought to a scientific convention in January. The U.S. Nuclear Regulatory Commission said the Soviets had unwittingly exported it to the United States and returning it would be an illegal export under the Atomic Energy Act. Soviet news agency described the act as a “regrettable breach of agreements” that would lead to questioning Soviet-U.S. nuclear cooperation. (AP, Apr 22/91)
- An editorial in a space publication stressed the need for space flight to gain some congressional advocates and for NASA's new launcher plan to be salvaged before it was too late. (SP News, Apr 22-28/91)
- Republican Congressman from California Tom Campbell said he would not object to the closing of a military installation in his district provided that it was “fair.” In this connection, he would not oppose the proposed closing of Moffett Field, from which NASA tests aircraft and spacecraft in wind tunnels and simulators and the Navy flies its P-3 Orion antisubmarine warfare missions over the Pacific. Local officials and business people argued that closure of the field would cause Lockheed Missiles and Space Company to move elsewhere, taking its 25,000 employees, in addition to the some 12,200 jobs lost from the Navy. (W Post, Apr 22/91)
- NASA's Jet Propulsion Laboratory, Pasadena, California, awarded a \$145 million contract to Loral Infrared and Imaging Systems, Lexington, Massachusetts to design and build the Atmospheric Infrared Sounder (AIRS). This instrument would fly on NASA's first Earth Observation System (EOS) satellite flights in 1998. AIRS would be a global thermometer in space to study the effects of increased greenhouse gases in the Earth's atmosphere. The main goal of EOS-A satellites is to study the effects of potential global warming through long-term observations. AIRS would operate continuously for five years. (NASA Release 91-61; WSJ, Apr 23/91)

April 23: An editorial summarized the achievements of 10 years of Shuttle flights. (B Sun, Apr 23/91)

- A British woman, Helen Sharman, was tentatively selected for the next international space flight with two Soviet cosmonauts to the Mir Space Station. (UPI, Apr 23/91)
- NASA indicated that the Shuttle Atlantis had landed 200 yards short of its lakebed runway at Edwards Air Force Base in California. The reason was that astronauts were unaware of the wind shift, of which ground controllers did not inform them because they thought the information was not needed. Measures have been taken to prevent similar incidents in the future by installing more

efficient brakes and a drag chute to help slow the aircraft after touchdown. (*O Sen Star*, Apr 23/91)

- Gerald Fishman, principal investigator of the Burst and Transient Source Experiment, said so far the experiment on the Gamma Ray Observatory was working as planned. (*Birmingham Post-Herald*, Apr 23/91)

- The media, in a series of articles, anticipated the launching of Shuttle Discovery, discussed preparations for blast off, and outlined tasks to be performed. (*NY Times*, Apr 23/91; *W Post*, Apr 23/91; *USA Today*, Apr 23/91; *CSM*, Apr 23/91)

- NASA was considering repairs costing at least \$50 million to the Hubble Space Telescope. In addition to the telescope proper, the question was whether to compensate for flaws in three other instruments: two spectrographs and the faint-object camera. Such repairs would involve Costar (Corrective Optics Space Telescope Axial Replacement) and cost \$30 million to \$40 million, while the telescope repair cost would be \$14 million. To test the feasibility of performing such repairs, mock spacewalks inside a huge water tank at Marshall Space Flight Center would determine whether the work could be accomplished in the estimated 16 hours required. Despite the need for such repairs, Edward Weiler, NASA program scientist for the observatory, stressed the achievements the Hubble Telescope had made in revealing the universe. (*NY Times*, Apr 23/91; *B Sun*, Apr 23/91; *Birmingham News*, Apr 23/91; *AP*, Apr 23/91; *UPI*, Apr 23/91)

- Hours before Space Shuttle Discovery was to blast off on its "Star Wars" mission, NASA canceled the launch because of the failure of an electrical sensor that measures pressure on an oxidizer turbopump on the engine. (*AP*, Apr 23/91; *UPI*, Apr 23/91; *NY Times*, Apr 24/91; *W Post*, Apr 24/91; *W Times*, Apr 24/91; *USA Today*, Apr 24/91; *LA Times*, Apr 24/91; *C Trin*, Apr 24/91; *AP*, Apr 24/91)

April 24: NASA announced the rescheduling of the launch of Discovery for April 28. (NASA Release - Launch Advisory; *B Sun*, Apr 25/91; *NY Times*, Apr 25/91; *USA Today*, Apr 25/91; *AP*, Apr 25/91; *UPI*, Apr 25/91)

- NASA Administrator Richard H. Truly announced the ceremony that would take place on April 25 on the occasion of the rolling out of the new Space Shuttle Endeavour. The ceremony was scheduled for Air Force Plant 42 in Palmdale, California, where the orbiter was assembled by Rockwell International Corporation's Space System Division. Truly praised the efforts of all those in NASA and industry who had cooperated on the program. Part of the ceremony would involve the presentation to NASA by Robert Duce, Dean of the University of Rhode Island's Graduate School of Oceanography,

of Endeavour's first "payload," a sternpost remnant recovered from the orbiter's namesake, the first ship commanded by British explorer Captain James Cook in 1768-71. During the ceremony Truly announced the creation of the NASA Endeavour Teacher Fellowship Program with the gifts donated to NASA by the public for the replacement orbiter. The program would award scholarships to American undergraduates studying to be teachers. (NASA Release 91-62; UPI, Apr 24/91; NASA Release 91-64)

- The House Committee on Science, Space, and Technology approved a \$14.27 billion space program for the next fiscal year, an increase of nearly six percent over 1991 but \$488 million less than President Bush had requested. Included was \$1.9 billion for the Space Station with \$128.9 million to be added when the National Academy of Sciences comments on NASA's plans to reduce the size of the station. The committee specified that NASA spend \$25 million of the Space Station money on developing a return emergency vehicle for Space Station astronauts. It also called for spending \$30 million to develop advanced propulsion systems, including the first new Shuttle engine in more than 20 years. Closer scientific cooperation with the Soviet Union and continuation of the Landsat earth-monitoring program were also specified. (AP, Apr 24/91)

- The Magellan spacecraft was into the second mapping of Venus, causing scientists to hope the second set of images might reveal changes in the landscape showing volcanic or other activity. (LA Times, Apr 24/91)

April 25: The *Christian Science Monitor* reviewed environmental challenges facing scientists worldwide. Commenting on greenhouse gases, it stated that the international program of Canada, the European Space Agency, Japan, and the United States would help fill knowledge gaps. Within this framework, NASA's Mission to Planet Earth formed a major part. This included the need to analyze the hydrological cycle over the oceans, represented in part by the use of a spectrometer supplied by NASA's Jet Propulsion Laboratory in Pasadena, California. The lower atmosphere also needed study, as was pointed out by Jack Fishman of the NASA Langley Research Center in Hampton, Virginia. Such study would include investigation of the "self-cleaning ability" represented by the hydroxyl radical. (CSM, Apr 25/91)

April 26: NASA announced that the Hubble Space Telescope had completed one year of operation on April 25. Joseph H. Rothenberg, Associate Director of Flight Projects for Hubble Space Telescope at Goddard, summarized the Hubble's achievements. These included the taking of various images and presentation of data from observations at key scientific meetings. Scientists planned to compensate for the spherical aberration by modifying the telescope's replacement instruments. These included the placement of the Wide Field/Planetary Camera II in 1993 and further servicing plans during astronaut space walks. (NASA Release - Hubble Space Telescope; LA Times, Apr 29/91)

- NASA Project Scientist Steve Saunders stated that Magellan scientists at NASA's Jet Propulsion Laboratory, Pasadena, California, were studying the surface features on Venus caused by wind. Soviet landers and the U.S. Pioneer probes measured wind speeds near Venus at two to four miles per hour, or about the speed needed to move sand grains. The Magellan images indicated wind streaks. Project Manager Tony Spear said that a new strategy to protect Magellan from the heat of direct sunlight has cooled the spacecraft successfully. (NASA Release 91-63)
- NASA Administrator Richard Truly announced the appointment of J. Stuart Fordyce as Deputy Director of NASA Lewis Research Center, Cleveland. He had served as Director of Aerospace Technology at Lewis since 1984. (NASA Release 91-65)
- The media covered the unveiling of the Shuttle Endeavour at some length, including its new features outlined by NASA Administrator Richard Truly: "The latest avionics navigation equipment, the finest mechanical systems, a new drag chute, and equipment for longer duration flights." Endeavour has more fuel cells, which generate electricity, allowing it to stay in orbit as long as 28 days. (*P Inq*, Apr 26/91; *W Times*, Apr 26/91; *NY Times*, Apr 26/91; *W Post*, Apr 26/91; *USA Today*, Apr 26/91; *WSJ*, Apr 26/91; *B Sun*, Apr 26/91; *LA Daily News*, Apr 26/91; *H Chron*, Apr 26/91; *AP*, Apr 26/91; *UPI*, Apr 26/91)
- Preparations for the launching of Discovery were discussed at the beginning of a three-day countdown. The Discovery's mission was described as mimicking the movements of a ballistic missile to help scientists working on the antimissile defense system. (*NY Times*, Apr 26/91; *AP*, Apr 26/91; *UPI*, Apr 26/91; *LA Times*, Apr 26/91; *W Post*, Apr 28/91; *B Sun*, Apr 28/91; *NY Times*, Apr 28/91)

April 27: Engineers at the Jet Propulsion Laboratory in Pasadena, California, managed by the California Institute of Technology for NASA, feared it might be necessary to send a communications satellite to Jupiter to relay Galileo's discoveries to Earth. It would take three years for such a satellite to reach Jupiter, assuming funding were available. However, the engineers still hoped to resolve the problem of the failure of Galileo's high-gain antenna to open properly. Six nearly identical antennas were used on NASA's primary communications satellites without encountering problems. (*LA Times*, Apr 27/91; *B Sun*, Apr 28/91; *W Post*, Apr 30/91; *NY Times*, Apr 30/91)

- The California Institute of Technology and the University of California, with funding from the W.M. Keck Foundation, were preparing to build a new \$93.3 million Keck II telescope in 1992 on top of Hawaii's Mauna Kea volcano, adjacent to the Keck I being completed. Foundation chairman Howard B. Keck announced that the foundation would pay \$74.6 million for the sec-

ond telescope. Edward C. Stone, Director of NASA's Jet Propulsion Laboratory, said scientists were sure NASA would get congressional approval to finance the remainder. The linked telescopes, according to Stone, "can explore the origin of the visible universe by peering back to the first 1 billion to 2 billion years after the Big Bang, when we believe that galaxies began to form out of the residue of the Big Bang." (*C Trib*, Apr 27/91; *B Sun*, Apr 27/91; *NY Times*, Apr 27/91; *LA Times*, Apr 27/91; *W Post*, Apr 27/91; *CSM*, Apr 29/91)

April 28: As the thirtieth anniversary of his trip as America's first space pioneer approached, Alan Shepard reminisced about his vivid recollections of that flight on May 5, 1961 as well as the 33 hours he spent on the Moon 10 years later. Since that day in 1961, NASA has launched 70 manned flights with 161 individuals. (*LA Times*, Apr 28/91)

- NASA stated that Endeavour would not be convoyed through Lancaster as previous Shuttles were, but instead would fly via a 747 jet to Houston's Johnson Space Center. There a dedication ceremony would be held before Endeavour was flown to Florida to prepare for its mission. (*Antelope Valley Press*, Apr 28/91)

April 29: Space Shuttle Discovery blasted off in what Mission Director Ronald D. Dittmore said was "probably the most complex flight flown to date." More than 60 Shuttle maneuvers were planned and 17 instruments were to be used to study the Shuttle's exhaust plumes, chemical releases, and the Earth's atmosphere. A problem with a tape recorder delayed the launch half an hour; after the launch further problems were experienced with two tape recorders. (*NY Times*, Apr 29/91; *USA Today*, Apr 29/91; *W Post*, Apr 29/91); *B Sun*, Apr 29/91; *CSM*, Apr 29/91; *P Inq*, Apr 29/91; *LA Times*, Apr 29/91; *AP*, Apr 29/91; *C Trib*, Apr 29/91; *UPI*, Apr 29/91)

- The rocket-launching site at Poker Flat, Alaska, is near the North Pole, has a high success rate for suborbital, scientific launches, and lacks military red tape, being university owned. These factors caused commercial ventures to inquire about possible commercial satellite launches into polar orbits from Poker Flat. Glenn Olds, commissioner of the State Department of Commerce and Economic Development, believed a launch might occur in 1993. (*AP*, Apr 29/91)

- An editorial in a space journal commented on the work of cosmonauts in the Soviet Mir Space Station who are conducting advanced materials and fluids experiments in at least five processing systems. In addition, Soviet engineers were preparing several evolutionary unmanned materials spacecraft that would provide Soviet scientists more processing time in unmanned spacecraft than their U.S. counterparts. Whereas these Soviet facilities presented opportunities

for use by American researchers for experimental purposes, which they were doing increasingly, a challenge was also presented to the United States. NASA bureaucracy and deficiencies in the U.S. microgravity program, for example, resulted in it taking some researchers two years to book commercial processing flights on the Shuttle. Although NASA planned microgravity budget increases from \$125 million in FY 1992 to \$225 million in FY 1995, this would require White House and congressional support. (*AvWk*, Apr 29-May 5/91)

- Representative Barbara Boxer, Democrat from California, chair of the House Government Operations subcommittee on government activities and transportation, announced a hearing about the Space Station. Boxer said the General Accounting Office report and the analysis of her staff revealed “astronomical” differences between NASA cost estimates for the Space Station and “more objective, independent analyses.” (*AvWk*, Apr 29-May 5/91)

- A policy paper by the Heritage Foundation, a conservative Washington think tank, said defense and national security should be top priority for the U.S. space program. Exploration of the Moon and Mars should occur as a result of “market incentives” or interest of research organizations. Environmental research should be the province of the National Oceanic and Atmospheric Administration or the Department of Energy. If NASA’s functions could be performed by other agencies, it should be closed. (*AvWk*, Apr 29-May 5/91)

- Daniel DeVito, manager of the Central Data Handling Facility (CDHF) at NASA’s Goddard Space Flight Center, commented on the way the use of CDHF in the forthcoming NASA Upper Atmosphere Research Satellite mission might lead to similar systems on larger NASA projects. CDHF was a new concept that both the International Solar Terrestrial Physics project and the Earth Observing System mission were looking at to handle data more efficiently and distribute data to scientists through a multiple network. (*Federal Computer Week*, Apr 29/91)

- Tom McGlynn, a Computer Sciences Corporation software scientist for the Gamma Ray Observatory (GRO) Science Support Center at Goddard Space Flight Center in Greenbelt, Maryland, described four data analysis systems developed for GRO. The GRO launched by Atlantis carried four instruments designed to study overlapping portions of gamma rays, the highest energy radiation in the electromagnetic spectrum. (*Federal Computer Week*, Apr 29/91)

April 30: The crew of Shuttle Discovery prepared for a 38-hour “space ballet” with a satellite that will study Discovery’s exhaust plumes. With two recorders not working, the astronauts turned to other instruments. The satellite launch was delayed to allow the crew to complete as many observations as possible of Earth’s aurora before the coolant for the telescope ran out. (*B Sun*, Apr 30/91;

W Times, Apr 30/91; *W Post*, Apr 30/91; *USA Today*, Apr 30/91; *LA Times*, Apr 30/91; AP, 30 Apr 91; UPI, 30 Apr/91)

- The Department of Energy requested \$30 million to create a new space exploration program relating to civilian space activities. The new request brought the Energy Department's 1992 budget request for space exploration to \$142 million, compared with NASA's \$94 million. Some experts and officials saw the Energy Department's role in space as desirable, both to prevent NASA's monopoly and because the Department maintained active technology development programs whereas NASA allowed its technology research and development to wither as it struggled with existing programs. (*W Post*, Apr 30/91)

- A proposal that \$211 million be spent on the chance that gravity waves could be exploited to fathom black holes and other cosmic enigmas divided scientists and faced Congress with a quandary. Involved was possible Federal funding of two proposed gravity wave observatories, a joint project of the California Institute of Technology and the Massachusetts Institute of Technology. American supporters of the project, the Laser Interferometer Gravitational-Wave Observatory (LIGO), admitted there was no guarantee of success but believed its scientific potential was gigantic if it succeeded. (*NY Times*, Apr 30/91)

- Charles A. Bowsheer, comptroller general of the General Accounting Office, estimated that NASA had underestimated by \$10 billion the construction cost of the Space Station because it did not include the costs of flying the Shuttle during Station construction, developing the crew lifeboat, conducting scientific projects, and installing certain equipment. NASA underestimated operations costs by \$24 billion because it omitted Shuttle flight costs, salaries of ground-based personnel, the cost of research, and added electrical power. (AP, Apr 30/91)

May

May: The *AOPA Pilot* reported that as a result of two 1989 and one 1990 near-midair-collision incidents involving NASA astronauts flying T-38A Talons, the NTSB made recommendations to NASA and the FAA. Such planes required the pilot to fly manually without an autopilot and to navigate while communicating with air traffic control (ATC). The NTSB recommended the NASA planes be equipped with altitude alerting devices and upgraded navigation/communication equipment as well as weather radar and that pilots write down ATC instructions and file for preferred routes. (*AOPA Pilot*, May 1991)

May 1: The NASA Lewis Research Center, Cleveland, selected Cortez III Service Corporation, Alamogordo, New Mexico, for a \$140 million support service contract for center operations. (NASA Release C91-n)

- According to the media, in a General Accounting Office (GAO) report to be submitted to Congress, NASA underestimated the cost of building the redesigned Space Station by \$10 billion and the cost of operating it through the year 2027 by about \$24 billion. GAO is to submit the report, its first since the Space Station restructuring, to the House Government Operations Subcommittee on Government Activities and Transportation. Comptroller General Charles A. Bowsher in the report questioned the cost value because only one of the original eight Space Station uses, that of a research outpost, was being met. (*W Post*, May 1/91; *NY Times*, May 1/91)

- Discovery astronauts captured amazing aurora observations and continued to try to fix the two faulty recorders. After releasing the retrievable SPAS-2 satellite, using Discovery's 50-foot robot arm, the astronauts had difficulties getting the satellite oriented properly to observe the Shuttle. Discovery was to play the role of an enemy missile, repeatedly firing one of its two orbital maneuvering system rockets as instruments on the SPAS-2 recorded visible light, infrared, and ultraviolet emissions. (*W Times*, May 1/91; *P Inq*, May 1/91; *AP*, May 1/91; *UPI*, May 1/91; *LA Times*, May 1/91)

- President Bush barred the export to China of parts for a domestic communications satellite, known as Dong Fang Hong 3, citing concerns about possible proliferation of weapons of mass destruction. Bush approved export of components for two Western projects, an Australian communications satellite and a Swedish weather satellite, to be launched from China, for which the United States was assured of strict safeguards. (*W Post*, May 1/91; *NY Times*, May 1/91)

- Galileo, the Jupiter survey spacecraft, was scheduled to fly-by the asteroid Gaspra on October 29. Such an encounter would be a first and was compli-

cated by the failure of Galileo's antenna to deploy completely so that communications were minimized. (CSM, May 1/91)

May 2: The media gave extensive coverage to Discovery's maneuvers as it conducted missile-detecting experiments for the Pentagon. The scientific satellite, which it launched previously, captured with infrared sensors and television cameras engine exhaust plumes and plumes from smaller steering jets. (*B Sun*, May 2/91; *W Post*, May 2/91; *W Times*, May 2/91; *NY Times*, May 2/91; *USA Today*, May 2/91; *P Inq*, May 2/91; *LA Times*, May 2/91 AP, May 2/91; UPI, May 2/91; CSM, May 3/91)

- The press reported hearings of the Government Operations Subcommittee on Government Activities and Transportation at which NASA Administrator Richard Truly defended NASA against charges by the General Accounting Office (GAO) that it understated the cost of the planned Space Station and its operations through 2027 by at least \$34 billion. Truly questioned GAO figures and stated it was time to begin building the station rather than submit it to further study or audit. (*W Post*, May 2/91; *NY Times*, May 2/91; *W Times*, May 2/91; *WSJ*, May 2/91; *B Sun*, May 2/91; *P Inq*, May 2/91; *LA Times*, May 2/91; *Plain Dealer*, May 5/91)
- Space Shuttle Columbia began its trip from an assembly building at Kennedy Space Center to the launch pad at Cape Canaveral, a four-mile journey. (AP, May 2/91)
- NASA announced the selection of Lawrence J. DeLucas of the University of Alabama at Birmingham and Eugene H. Trinh of the Jet Propulsion Laboratory, Pasadena, California, to fly as payload specialists on the first U.S. Microgravity Laboratory mission, scheduled for June 1992. (NASA Release 91-66)
- NASA announced it was seeking applications from new astronaut candidates with a cut-off date of July 1, 1991. The next class of candidates was scheduled for July 1992. Two types of positions were available: mission specialist for those with significant scientific backgrounds and pilot for those with extensive piloting experience in jet aircraft. (NASA Release 91-67; *H Chron*, May 3/91)
- NASA announced that astronaut Mary L. Cleave would become Deputy Project Manager for Sea Viewing Wide Field Sensors at the NASA Goddard Space Flight Center, Greenbelt, Maryland. Her work would involve supervising a joint NASA and commercial project to learn about the biological mass in the ocean by studying the chlorophyll content to determine how much plankton is produced. (NASA Release 91-68; *H Chron*, May 3/91)

- David Webb of the White House National Commission on Space, speaking at a U.S. Space Foundation National Space Symposium in Colorado Springs, said that the commission in 1985 had recommended increased NASA spending for research and development. However, Admiral John Poindexter, then National Security Adviser, opposed it, with the result that no action was taken. (*Washington Technology*, May 2/91)

May 3: The House of Representatives voted to authorize NASA to spend \$14.9 billion in the next fiscal year, about \$500 billion less than President Bush had requested. The approval included the full \$2 billion Bush sought for Space Station Freedom. Concurrently, the House directed the National Academy of Sciences to study whether the goals of the Space Station could be achieved more cheaply by other means. (*W Post*, May 3/91; *W Times*, May 3/91; *WSJ*, May 3/91; *NY Times*, May 3/91)

- Astronauts on Space Shuttle Discovery aimed a research satellite at rocket fuel spewed in space, then captured the satellite and put it back in the Shuttle's cargo bay. (*W Post*, May 3/91; *WSJ*, May 3/91; *NY Times*, May 3/91; *LA Times*, May 3/91; *AP*, May 3/91; *UPI*, May 3/91)

May 4: The media reported that Discovery astronauts had succeeded in getting data from three scientific instruments to the ground by splicing wires and rearranging cables in a complicated operation. In this way, they bypassed the nonfunctioning recorders, based on procedures worked out from the ground. The astronauts earlier had performed additional tests involving fuel canisters hurled from the Shuttle. (*AP*, May 4/91; *UPI*, May 4/91; *NY Times*, May 4/91; *C Trin*, May 4/91; *LA Times*, May 4/91; *NY Times*, May 5/91; *P Inq*, May 5/91; *W Post*, May 5/91; *CSM*, May 6/91)

- The wire services commemorated astronaut Alan B. Shepard's flight 30 years ago on May 5 as the first American in space. (*AP*, May 4/91; *UPI*, May 4/91)

May 6: The Discovery astronauts conducted final experiments, celebrated the 30th anniversary of U.S. space flight on May 5, and prepared to return to Earth. (*P Inq*, May 6/91; *W Times*, May 6/91; *USA Today*, May 6/91; *B Sun*, May 6/91; *C Trin*, May 6/91; *AP*, May 6/91; *UPI*, May 6/91)

- UPI reported that new Space Shuttle Endeavour was delayed an additional day in its trip from the factory in California to Kennedy Space Center in Florida because of stormy weather. (*UPI*, May 6/91)

- According to UPI, an extraordinarily sharp picture of Jupiter taken by the Hubble Space Telescope showed the planet's turbulent atmosphere and the telescope's capabilities. (*UPI*, May 6/91)

- An editorial in a trade journal commended Rockwell International for completing Space Shuttle Endeavour on time and under budget, stating that NASA should expect the same standards of performance with regard to the Space Station. (*SP News*, May 6-12/91)

- The *Philadelphia Inquirer* reported that Mae Jemison, the first black female astronaut, who was scheduled to be a member of the crew of Endeavour in August 1992, had received an honorary doctor of science degree from Lincoln University. (*P Inq*, May 6/91)

May 7: The media reported that because of high winds in California, Space Shuttle Discovery landed at Kennedy Space Center in Florida. The right tire was severely damaged on landing, but the new stronger brakes worked well. In addition, twice as much fiberglass thermal tile filler would have to be replaced than was customary after a flight. The astronauts accomplished 32 of 33 planned primary observations, 18 of 21 secondary observations, and 41 of 44 category-3 experiments. (*P Inq*, May 7/91; *W Post*, May 7/91; *NY Times*, May 7/91; *USA Today*, May 7/91; *B Sun*, May 7/91; *WSJ*, May 7/91; *W Times*, May 7/91; *LA Times*, May 7/91; AP, May 7/91; UPI, May 7/91; *P Inq*, May 8/91; AP, May 8/91; UPI, May 9/91)

- The media reported on the failure of Orbital Science Corporation's Prospector rocket to take off from the NASA launch pad at Cape Canaveral. The rocket, produced by the Fairfax, Virginia firm, contained 500 pounds of scientific experiments. The flight was sponsored by NASA's Center for the Commercial Development of Space at the University of Alabama in Huntsville. (*W Post*, May 7/91; *W Times*, May 7/91; *LA Times*, May 7/91)

- An editorial in the *Christian Science Monitor* commended the "modest, sober plan" of NASA for the revised Space Station, saying that it would enable the United States to make progress in space and should not be judged simply on its cost. (*CSM*, May 7/91)

- Engineers began a practice countdown for Space Shuttle Columbia, and the four-man, three-woman crew prepared to begin dress rehearsal for a planned May 24 launching. The purpose of the nine-day 11th flight of Columbia was the Spacelab Life Sciences mission, the first spacelab dedicated to life sciences research. The crew were to perform experiments to evaluate the adaptation of humans to space flight as well as to conduct some experiments on animals in a gravity-free environment. The planned experiments were to be conducted in the Spacelab module. (NASA General Release 91-69; AP, May 7/91; UPI, May 7/91; UPI, May 13/91; AP, May 13/91; *B Sun*, May 14/91; *W Times*, May 14/91; *USA Today*, May 14/91)

- Space Shuttle Endeavour arrived at Kennedy Space Center. Considerable work remained to be done on the Shuttle, including the installation of the three main engines. (AP, May 7/91)

- NASA announced that its mobile teacher resource center, LASER, would be on display and open to the public and to Washington metropolitan area teachers during Public Service Recognition Week, May 9-11. (NASA Release N91-31)

- NASA announced the names of eight firms chosen as finalists in competition for the 1991 George M. Low Trophy for quality and excellence. The final selections were to be announced in November after validation of performance achievements. (NASA Release 91-70)

May 8: President George Bush received the crew of Space Shuttle Atlantis. (UPI, May 8/91)

May 9: The *Washington Times* reported that the Smithsonian Institution had decided to keep the National Air and Space Museum Annex at Dulles International Airport and scale down the project, which is to include the Space Shuttle Enterprise. The cost at Dulles would be \$8 million less than at Baltimore-Washington International Airport, and Virginia could make a larger contribution than Maryland to total costs. (*W Times*, May 9/91)

- A giant black granite "space mirror" at Cape Canaveral, Florida, honoring America's 15 fallen astronauts was prepared for dedication, five years after the Challenger disaster. The monument was dedicated by Vice President Dan Quayle on May 9, in the presence of relatives of the astronauts killed. (UPI, May 9/91; *B Sun*, May 10/91; *P Inq*, May 10/91; *W Times*, May 10/91; *USA Today*, May 10/91; *C Trin*, May 10/91; AP, May 10/91; UPI, May 10/91; *Newsweek*, May 13/91)

- NASA announced that based on satellite observations of Mexico's Yucatan Peninsula, researchers from NASA and Geo Eco Arc Research in La Canada, California, had located a "nearly perfect" semicircular ring of sink holes forming a crater more than 125 miles in diameter. The scientists believed that this evidence of an impact crater formed by a comet or asteroid might have caused the extinction of dinosaurs and other species about 65 million years ago. The findings were being published in *Nature* magazine. (NASA Release 91-71; UPI, May 9/91; *LA Times*, May 10/91; *San Francisco Examiner*, May 10/91; *Long Beach Press Telegram*, May 11/91; *LA Times*, May 27/91; *W Times*, May 31/91)

May 10: The press cited concern over "millions of pieces of trash zooming around in space" and the fear that they might hit the Hubble Space Telescope or some orbiting astronauts. The concern caused work on new debris-monitoring devices and a system to warn astronauts of impending collisions with space junk so they could take evasive action. The U.S. Space Command's space surveillance network already kept track of about 6,700 pieces of larger litter at least four inches in diameter that might damage a Space Station. (AP, May 10/91; *W Times*, May 24/91)

- UPI reported that the NOAA-D spacecraft developed by the National Oceanic and Atmospheric Administration (NOAA) and NASA was scheduled for launch on May 14. The satellite, which was to measure temperatures on Earth's surface, including oceans, and gathering data on solar radiation, might help scientists better predict floods and understand the causes of droughts. (UPI, May 10/91)

May 13: The *Washington Post* carried a lengthy article describing the need for a new cheaper, dependable space launch system and work being done to develop a new family of rockets. The proposed new National Launch System was to be a hybrid of old and new technology to reduce costs. The booster shell would derive from the Shuttle's external fuel tank, topped by a Titan IV cargo housing. The core would be a newly developed oxygen-hydrogen engine. The rockets would use from one to several engines and for heavy payloads could strap on advanced solid fuel boosters being developed. (*W Post*, May 13/91)

- *U.S. News and World Report* contained a feature article on the planet Venus that included findings of NASA's Magellan about the surface of Venus as well as earlier Pioneer-Venus mission mapping data. (*U.S. News and World Report*, May 13/91)

- NASA announced that NASA 816, a modified Convair F-106B, had been retired after more than 30 years of flight research. It was to be moved to the new Virginia Air and Space Center in Hampton. (NASA Release 91-73)

- NASA Administrator Richard H. Truly announced the creation of a new Systems Analysis and Concepts Office at NASA Headquarters, in accordance with the recommendations of the Advisory Committee on the Future of the U.S. Space Program. James D. Bain, who served as executive secretary of that committee, was appointed Director of the new office. (NASA Release 91-74; *SP News*, May 20-26/91)

May 14: The Magellan spacecraft temporarily lost contact with NASA's Jet Propulsion Laboratory in Pasadena, California, when its antenna was misdirected toward Earth. Contact was restored, and only 0.3 percent of the mission's scheduled surface mapping was lost. (*C Trim*, May 14/91)

- The *Baltimore Sun* reported that Johns Hopkins University astrophysicist Sam Durrance, who flew with Shuttle Columbia's Astro flight in December 1990, lobbied for an Astro-2 flight to continue use of the telescopes and other equipment that made significant scientific discoveries. Some NASA and other officials were giving the possibility serious consideration. (*B Sun*, May 14/91)

- A feature article in the *New York Times* discussed the impact of space rockets on the ozone layer. Reportedly, NASA estimated that each Shuttle flight injected some 75 tons of chlorine into the stratosphere. Dr. Michael J. Prather,

an atmospheric scientist at NASA's Goddard Institute in New York City, calculated that the lifting of nine Shuttles and six Titan IVs every year would add 0.3 percent to stratospheric chlorine, which in turn would destroy much less than one percent of the ozone there. This made the Shuttle a large source of pollution but small by comparison to any other industry such as refrigeration or solvents. (*NY Times*, May 14/91)

- The *New York Times* reported that although the weather satellite known as GOES-NEXT (from next generation of geostationary operational environmental satellite) was flawed and would not gather all the data it was designed to collect, the National Oceanic and Atmospheric Administration planned to launch it anyway because the existing main U.S. weather satellite, GOES-7, was nearing the end of its life. The GOES-NEXT program was more than three years behind schedule and was now scheduled for launch in October. (*NYT*, May 14/91)

- NASA announced its launching of the NOAA-D environmental satellite from Vandenberg Air Force Base, California. The satellite was to collect meteorological and environmental data and ultimately would replace NOAA-10, which was nearing the end of its life. (NASA Release N91-36; *W Times*, May 15/91; *USA Today*, May 15/91)

- NASA announced it would test a structural component made of advanced carbon-carbon composite material as part of the X-30 National Aerospace Plane (NASP) program. The material took years to develop and was stronger and lighter than metal. (NASA Release 91-75)

May 15: NASA announced the selection of IBM Federal Sector Division, Houston, for a contract to provide as many as 48 ground-based, mission operations main frame computer systems, peripheral equipment, and services. (NASA Release C91-o)

- NASA announced the selection of PacificCorp Capital, Inc., Reston, Virginia, for a contract for Institutional Automatic Data Processing (IADP). IADP was to support the Johnson Space Center, Houston, and the White Sands Test Facility, New Mexico. (NASA Release C91-p)

- *USA Today* featured an article on Challenger Centers for Space Science Education, which use simulated space missions to teach elementary and middle school students science, mathematics, teamwork, and technology. More than 10,000 fifth graders a year use the Greenbelt, Maryland center. (*USA Today*, May 15/91)

- According to AP, a General Accounting Office report stated that NASA improperly managed hazardous wastes, creating pollution problems that must be corrected at some of its nine centers. (AP, May 15/91)

- PR Newswire reported that Loral Space Information Systems awarded Control Data a \$6.5 million contract for a Flight Analysis and Design System to modernize mission planning for NASA's Space Shuttle program. (PR Newswire, May 15/91)

- According to AP, the Magellan space probe completed its main nine-month radar survey of Venus, mapping 84 percent of the surface. In the second phase, the remaining surface was to be covered. (AP, May 15/91)

May 16: The media reported that the House Appropriations Subcommittee, by a six to three vote, had agreed to cut all but \$100 million of the projected \$2 billion Space Station budget for the fiscal year beginning October 1991. The \$100 million was to be used to close the project and study two alternative space science projects. (*W Post*, May 16/91; *WSJ*, May 16/91; *W Times*, May 16/91; AP, May 16/91)

- UPI reported that workers at Baikonur Cosmodrome had rolled a Soyuz TM-12 rocket into place to take two Soviet cosmonauts and a British woman to the Mir Space Station in a commercial mission. (UPI, May 16/91; AP, May 16/91)

- *Washington Technology* conducted an interview with Representative F. James Sensenbrenner, Republican from Wisconsin and ranking Republican on the House Space Subcommittee. He predicted NASA would face cost-overrun scandals in the coming years because when NASA lacked funds to pay contractors it tended to stretch out project completion. (*Washington Technology*, May 16/91)

- According to *Washington Technology*, Citizens Against Government Waste had prepared a study indicating that NASA's proposed Earth Observing System was to double in cost to \$60 billion but would not be able to meet its technical objectives because its key sensors were not "fundamentally different" from previous sensors. (*Washington Technology*, May 16/91)

May 17: The press carried accounts of administration statements, led by Vice President Dan Quayle, vowing to fight to save the Space Station despite the Appropriations Subcommittee action. (*P Inq*, May 17/91; *W Post*, May 17/91; *B Sun*, May 17/91; AP, May 17/91; UPI, May 17/91)

- UPI reported that the Hubble Space Telescope had detected gas clouds that appear to be from the universe's early day much nearer Earth than previously thought possible. NASA also released pictures taken by Hubble of an unusual jet spouting from a massive, unstable star called Eta Carinae, which upset existing ideas about how the star spewed out matter. (UPI, May 17/91)

May 18: The media reported that a British woman, Helen Sharman, went into space in a Soyuz TM-12 rocket with two Soviet astronauts, destined for Space

Station Mir. The astronauts were to remain on Mir to do repairs while Sharman was to return with the two Soviet astronauts now on Mir. (AP, May 18/91; UPI, May 18/91; *B Sun*, May 19/91; *P Inq*, May 19/91; *NY Times*, May 19/91; *LA Times*, May 19/91)

- The media carried extensive coverage of the preparatory stages for the mission of Space Shuttle Columbia and its crew. The four medical specialists were to conduct tests on human body functions while the three astronauts flew the Shuttle and were subject to some of the tests. Scientists hoped to learn why astronauts return to Earth with weakened immune systems, reduced bone mass, a decrease in body fluid or blood, fewer red blood cells, and less muscle protein, as well as space motion sickness. The 30 white rats and 2,478 tiny jellyfish being carried were to be analyzed after the flight. (AP, May 18/91; UPI, May 18/91; *B Sun*, May 19/91; *P Inq*, May 19/91; *LA Times*, May 19/91; *W Post*, May 20/91; AP, May 20/91; UPI, May 20/91; CSM, May 20/91; *NY Times*, May 21/91; *USA Today*, May 21/91; UPI, May 21/91)

- According to the press, Al Boggess, an astronomer at NASA's Goddard Space Flight Center, at a news briefing at the Space Telescope Science Institute in Baltimore announced that the Hubble Space Telescope had observed that a gas disk that ringed the star Beta Pectoris appeared to include large clumps of matter spiraling in toward it at speeds of up to 120 miles a second. This was a "new phenomenon, not seen around any other star." (*NY Times*, May 18/91; *C Trin*, May 19/91; CSM, May 22/91)

May 19: The *Baltimore Sun* commented at length on an article on galactic studies appearing in the April 20 issue of *The Astrophysical Journal*. The article described work done by a group of scientists using the International Ultraviolet Explorer (IUE), a scientific satellite operated by NASA and the European Space Agency. The yearlong work required 60 observations with the IUE studying the cores of rare galaxies. (*B Sun*, May 19/91)

May 20: NASA announced that the second Astro mission, dedicated to astrophysics, would fly aboard the Space Shuttle. The success of the first Astro mission and the ability of the instruments to acquire high-quality scientific data were major reasons for the decision. The following instruments were to fly on Astro-2 to observe the ultraviolet part of the electromagnetic spectrum: the Hopkins Ultraviolet Telescope, which performs spectroscopy; the Ultraviolet Imaging Telescope, which produces images of components of nebulae, stars, and galaxies; and the Wisconsin Ultraviolet Photopolarimeter Experiment, which measures light polarization. (NASA Release 91-76; AP, May 20/91; *B Sun*, May 21/91)

May 21: The media carried comments by William B. Lenoir, NASA Associate Administrator, that if the congressional appropriations process did not restore the cut in the Space Station funding, it would kill the project and signal that

the United States “was going out of the manned space business.” In addition, some media articles commended Congress for its action or raised serious questions about NASA’s new design or its education of the public about the need for a Space Station. (*NY Times*, May 21/91; *AP*, May 21/91; *B Sun*, May 21/91; *SP News*, May 20-26/91)

- Orbital Sciences Corporation, Fairfax, Virginia, rescheduled its launch of the Joust 1 rocket at Cape Canaveral for June 5, according to the *Washington Times*. (*W Times*, May 21/91)
- *USA Today* carried an article concerning the large growth of communities and companies along the “Space Coast” of Florida as a result of the success of the Shuttle program. Figures of population increases, numbers of workers, and firm incomes were given. (*USA Today*, May 21/91)
- *USA Today* reported that five years later NASA was still tracking down debris from Challenger in the hands of collectors because the Space Shuttle was government property. (*USA Today*, May 21/91)
- According to UPI, Soviet President Mikhail Gorbachev hailed the crew members of Mir on their successful docking of the TM-12 capsule. (UPI, May 21/91)
- The press reported that the panels of the astronaut memorial monument that developed jagged cracks are being investigated. (*AP*, May 21/91; *USA Today*, May 22/91; *LA Times*, May 22/91)

May 22: NASA announced the postponement of the launch of Space Shuttle Columbia because of last minute problems discovered: two computer devices and nine four-inch temperature sensors. The flight was to be delayed at least 11 days. Reasons for the delay in finding the flaws were discussed. (*P Inq*, May 22/91; *NY Times*, May 22/91; *W Post*, May 22/91; *USA Today*, May 22/91; *AP*, May 22/91; UPI, May 22/91; *LA Times*, May 22/91; *P Inq*, May 23/91; *NY Times*, May 23/91; *W Post*, May 23/91; *USA Today*, May 23/91; *AP*, May 23/91; UPI, May 23/91)

- According to the *New York Times*, Japan was reassessing its decision that preserving good trade relations with the United States was more important than quickly developing a competitive space industry. Because its own heavy-lift rocket program ran into endless problems and delays, Japan turned to foreign companies to launch its satellites. But the two satellite accidents, of which the most recent was the loss of the Atlas Centaur rocket launched from Cape Canaveral by General Dynamics Corporation earlier in 1991, caused considerable Japanese concern. The loss had a major impact on Japan’s high-definition television projects, which were developing rapidly. (*NY Times*, May 22/91)

- Queen Elizabeth visited Johnson Space Center in Houston. (AP, May 22/91; *W Times*, May 23/91; *LA Times*, May 23/91; UPI, May 23/91)

May 23: The media reported that President Bush had informed two senators, Barbara Mikulski, Democrat of Maryland, and Jake Garn, Republican of Utah, both on the Senate space subcommittee, and NASA Administrator Richard Truly that he would actively campaign to reverse the congressional panel's decision to scuttle the Space Station. (AP, May 23/91; *B Sun*, May 24/91; *W Post*, May 24/91)

- NASA announced it would hold the first Long Duration Exposure Facility (LDEF) Post-Retrieval Symposium June 2-8, 1991, in Kissimmee, Florida. LDEF exposed 57 science and technology experiments to the space environment for almost six years until Shuttle Columbia returned it to Earth in January 1990. The conference was planned to examine the results of LDEF and the effects of a long-term space environment on materials and systems. (NASA Release N91-38)

May 24: According to the *Wall Street Journal*, Telesat Canada planned to file a \$240 million insurance claim because of the failure of its Anik E2 communications satellite launched in April to deploy one of its two antennae. (*WSJ*, May 24/91)

- The *Washington Times* reported that NASA's Johnson Space Center near Houston had 842 pounds of moon rocks brought back by 12 moonwalkers on six Apollo flights between 1969 and 1972. The rocks are loaned to scientific groups for study. Each nation in the world also has a small piece of Moon rock, sent at President Nixon's instruction in the early 1970s. (*W Times*, May 24/91)

May 24: The media reported that NASA engineers had debated whether to remove additional sensors in Columbia that might be cracked. NASA planned to create a new investigative team to review the process of flaw detection. (*NY Times*, May 24/91; *W Post*, May 24/91; *B Sun*, May 24/91; *W Times*, May 24/91; *USA Today*, May 24/91; AP, May 24/91; UPI, May 24/91)

- NASA announced that David Reasoner, Combined Release and Radiation Effects Satellite (CRRES) project scientist at NASA's Marshall Space Flight Center, Huntsville, Alabama, would chair the May 28 meeting of the American Geophysical Union in Baltimore. At the session, results of the CRRES artificial Earth auroras experiment would be discussed. (NASA Release 91-77)

- NASA announced the May 30 harvesting of its first research crop of lettuce grown in a specially outfitted chamber at Johnson Space Center, Houston, by the Engineering Directorate's Crew and Thermal Systems Division. This harvest was to follow a test crop harvested in February as part of the Regenerative

Life Support Systems program focused on recycling air and water and producing food, as part of NASA's future long duration missions on the Moon and Mars. (NASA Release 91-78)

- NASA Administrator Richard H. Truly announced, following a senior management meeting, that NASA would conduct a thorough review of the recent discovery that a fuel sensor removed from Space Shuttle Columbia last fall was cracked. However, Truly indicated that the sensor problem on Columbia had been corrected and the Shuttle was now tentatively scheduled for launch on June 1. (NASA Release 91-79; AP, May 25/91; UPI, May 25/91)

May 25: The *Washington Post* cited the Synthesis Group unpublished report stating that although a Space Station in Earth orbit was preferable, if such could not be built in timely fashion and with the desired capabilities, one could consider using the moon as a preparatory environment for a Mars mission. (*W Post*, May 25/91)

In a subsequent editorial, *Space Propulsion* newsletter urged that the press conference on the report be eliminated and the report be published as soon as possible. (*SP News*, May 27-June 2/1991)

- According to the *Los Angeles Times*, NASA personnel were warning elected officials across the country that the killing of the Space Station would mean lost jobs in their districts. (*LA Times*, May 25/91)

May 26: Major articles in the *New York Times* and the *Los Angeles Times* raised questions about NASA's proposed Space Station with regard to its cost, the functions it was supposed to perform, and the need for such space ventures in relation to other needed expenditures. The *Los Angeles Times* stated that Soviet Space Station experience showed that "at current levels of technology, reusable spaceships were more expensive than throwaway models." (*NYT*, May 26/91; *LA Times*, May 26/91)

May 27: Tass announced that the first British astronaut and two Soviet cosmonauts had returned safely from Mir Space Station, landing on the steppes of Kazakhstan. Soviet space officials considered British participation valuable in terms of Soviet-British cooperation, although commercially the mission failed to gain British sponsorship. (UPI, May 27/91)

- A space journal editorial advocated that the Space Station be judged by Congress on its own merits and that space exploration was also a social need, medically, environmentally, and agriculturally. NASA did what Congress requested and the committee needed to explain its failure to approve the revised Space Station plans. (*AvWk*, May 27/91)

May 28: NASA announced that a new Crew Transport Vehicle (CTV) had been developed to allow the crew efficient egress after Shuttle flights to facilitate life science or medical investigations. The CTV was a renovated "people mover." (NASA Release 91-80)

- Gerald Fishman, a NASA astrophysicist at the Marshall Space Flight Center, Huntsville, Alabama, announced at a conference of the American Astronomical Society in Seattle that the Burst and Transient Source Experiment (BATSE) carried on NASA's Gamma Ray Observatory was detecting gamma-ray bursts with greater sensitivity than previously. (NASA Release 91-81; UPI, May 28/91)

- Officials of the European Space Agency and NASA's Jet Propulsion Laboratory in Pasadena, California, announced that scientific teams concerned with the Ulysses mission to the poles of the sun were preparing for physics investigations during Ulysses's forthcoming encounter with Jupiter. Ulysses was expected to reach Jupiter and its satellites on February 8, 1992, and make a two-week sweep past the planet. (NASA Release 91-82)

- NASA's Lyndon B. Johnson Space Center (JSC), Houston, announced that it had selected Johnson Controls World Services, Inc., Cape Canaveral, Florida, for a JSC plant maintenance and operation support contract. (NASA Release C91-q)

- According to the press, the Japanese government was angry that its participation in the proposed Space Station was threatened by congressional budget cuts. Reportedly, it issued a warning that it might refuse to contribute to U.S.-led major scientific projects in the future unless plans to build the Space Station remain intact. (NYT, May 28/91; UPI, May 28/91)

- UPI reported that ground had been broken for the \$70 million Space Center Houston being built just outside Johnson Space Center. The center is to be an "experience center" providing visitors with a sense of daily Space Station life. (UPI, May 28/91)

May 29: The media covered the completion of sensor repairs, the beginning of the second countdown for Columbia's medical research mission, continuing preparations for the launch, and final clearance for the launch. (W Post, May 29/91; W Times, May 29/91; USA Today, May 29/91; AP, May 29/91; UPI, May 30/91; AP, May 30/91; USA Today, May 31/91; W Times, May 31/91; AP, May 31/91; UPI, May 31/91)

- At a press conference associated with the American Astronomical Society meeting in Seattle, Ted Stecher, Ultraviolet Imaging Telescope (UIT) principal investigator, announced that UIT team members had identified hundreds of newly found young stars in the Large Magellanic Cloud. Several of these hot stars might eventually become supernovas. (NASA Release 91-84)

- NASA announced that at its Ames-Dryden Flight Research Facility, at Edwards, California, simulator research showed that multiengine aircraft with specially programmed flight control systems could touch down safely using only the engines to turn and land. (NASA Release 91-85)
- According to AP, a communications satellite needed to transmit long-distance telephone calls made in Alaska was successfully launched from Cape Canaveral Air Force Station. (AP, May 29/91; *W Post*, May 30/91)
- AP reported that The Save Our Wetlands environmental group had filed suit against NASA to stop the testing of an advanced solid fuel rocket motor for Space Shuttles on the Mississippi Gulf Coast. The group also asked that the Environmental Protection Agency make NASA comply with clean air and water laws. NASA officials maintained that NASA received the needed State and Federal permits to test the boosters. (AP, May 29/91)
- Nationally syndicated economics columnist Warren Brookes questioned the administration's efforts to rescue NASA's Space Station and the new space program represented by the National Aerospace Plane. Brookes stated that possibly national security concerns justified both these programs but their economic justification was dubious. (*W Times*, May 29/91)
- According to the *Fairfax Journal Weekly*, C. McClain Haddow, a Herndon, Virginia lobbyist, asserted that if NASA were to leave Reston for Houston, probably other Federal offices would move from Northern Virginia as well. (*Fairfax Journal Weekly*, May 29-30/91)

May 30: The media gave extensive coverage to Magellan's completion of its initial nine-month mapping of Venus and the amazing discoveries made. To date, 84 percent of Venus was mapped and in the second phase chief project scientist Stephen Saunders stated that 95 percent of Venus' surface was expected to be covered. Magellan's powerful radar system enabled it to penetrate the clouds of carbon dioxide that cover Venus. (*NY Times*, May 30/91; *USA Today*, May 30/91; *B Sun*, May 30/91; UPI, May 30/91; AP/May 30/91; CSM, May 31/91)

- At a meeting of the American Astronomical Society in Seattle, research physicist Michael S. Briggs reported finding a second huge source of gamma rays in the Milky Way. The Soviet satellite Granat and a gamma detector aboard NASA's Gamma Ray Observatory were to be used to observe the new source. (*LA Times*, May 30/91)

May 31: The *Philadelphia Inquirer* carried an article about the new issue of *Science* magazine and its reports on the likely creation of holes in the Arctic ozone. The article quoted Robert Watson, head of NASA's atmospheric ozone

program, as saying that Earth's ozone layer was declining as much as eight percent each decade; scientists previously thought it was only two to four percent. Also NASA research found that losses occurred in the spring as well as winter, raising concern that ultraviolet radiation might threaten crops, forests, and ecological processes. (*P Inq*, May 31/91)

- NASA officials George Rodney, the Agency's top safety official, and Robert Crippen, head of the Shuttle program, said a special investigating team would spend the summer reviewing the way NASA approved Shuttle components for flight. (*W Post*, May 31/91)

- NASA announced that astronaut John M. Lounge would leave NASA June 21 to become director of Houston Operations for Spacehab, Inc., which is providing a pressurized module for future space flights. (NASA Release 91-86)

- In an article on the budget process, the *Christian Science Monitor* stated that despite it being a Bush Administration priority, the Space Station may go in the budget because of the deal to bring the Federal deficit under control. (*CSM*, May 31/91)

June

June 1: The media reported that the launch of Shuttle Columbia was again postponed because of problems with the navigation equipment. (UPI, Jun 1/91; AP, Jun 1/91; *P Inq*, Jun 2/91; *W Post*, Jun 2/91; *NY Times*, Jun 2/91; *LA Times*, Jun 2/91; CSM, Jun 3/91; *USA Today*, Jun 3/91)

June 3: According to AP, NASA began its third countdown for the launch of Columbia, rescheduled for June 5. (AP, Jun 3/91)

- NASA announced that Joust 1, a commercial suborbital rocket, would be launched from Cape Canaveral on June 7. (NASA Release, unnumbered)
- The press reported on Bush administration efforts to save Space Station Freedom in the light of actions of the House Appropriations Committee as well as the protests of participating nations that were angered at congressional action, such as Japan, Canada, and the European Space Agency. (*B Sun*, Jun 3/91; *W Post*, Jun 3/91)
- In an article by NASA Deputy Administrator J.R. Thompson, he called on the White House to rescue the Space Station, citing its contribution to maintaining American leadership in space, international cooperation in science and technology, jobs, and education, in addition to its specific scientific research contributions. (*Roll Call*, Jun 3/91)
- *Newsweek* carried a feature article about NASA's discoveries regarding the heavens: quasars, galaxies, black holes, dark matter, and the like, as presented at the annual meeting of the American Astronomical Society. Special credit was given to the instruments NASA developed to explore space. Highlighted were the mysteries remaining to be explored and the new telescopes being installed to catch infrared rays to help solve some of the mysteries. (*Newsweek*, Jun 3/91)

June 4: NASA announced the award of an avionics systems engineering and analysis support contract to the Charles Stark Draper Laboratory, Cambridge, Massachusetts. The work was to include work on Space Station Freedom as well as Space Shuttles and advanced spacecraft, manned and unmanned. (NASA Release C91-s)

- NASA issued a release indicating that as a result of Apollo data findings NASA scientists and other researchers had a revised theory of the origin of life on earth. Life may have begun more than once and been wiped out several times by rare, planet-melting superimpacts on the Earth. Evidence of such early solar system impacts is well-preserved on the Moon. (NASA Release 91-87; UPI, Jun 5/91; AP, Jun 5/91; *San Jose Mercury News*, Jun 6/91)

- The press reported the House Appropriations Committee action voting to kill NASA's Space Station and ignoring a White House veto threat in that regard. (*W Post*, Jun 4/91; *B Sun*, Jun 4/91; *USA Today*, Jun 4/91; *W Times*, Jun 4/91; *P Inq*, Jun 4/91; *WSJ*, Jun 4/91; *AP*, Jun 4/91; *UPI*, Jun 4/91; *SP News*, Jun 3-9/91; *LA Times*, Jun 4/91)

- The media covered preparations for launching by the crew of Shuttle Columbia. (*AP*, Jun 4/91; *UPI*, Jun 4/91; *NY Times*, Jun 5/91; *W Times*, Jun 5/91; *USA Today*, Jun 5/91; *W Post*, Jun 5/91; *B Sun*, Jun 5/91; *P Inq*, Jun 5/91)

June 5: According to the media, the Bush Administration was pressuring Congress to retain the appropriation for the Space Station. (*NY Times*, Jun 5/91; *W Times*, Jun 5/91; *USA Today*, Jun 5/91; *W Post*, Jun 5/91; *AP*, Jun 5/91; *UPI*, Jun 5/91)

June 6: Extensive coverage was given to the launch of Columbia on June 5 and the astronauts' biomedical studies. (*B Sun*, Jun 6/91; *P Inq*, Jun 6/91; *NY Times*, Jun 6/91; *W Post*, Jun 6/91; *W Times*, Jun 6/91; *C Trin*, Jun 6/91; *LA Times*, Jun 6/91; *AP*, Jun 6/91; *UPI*, Jun 6/91)

- The media reported on Administration efforts to have the elimination of funding for the Space Station reversed in the House of Representatives. In this connection, the *New York Times* carried a major editorial urging that the Space Station not be funded. In response to that editorial, NASA Administrator Richard H. Truly released a letter of support for the Space Station from Thomas Stafford, Chairman of the Synthesis Group, to Representative George Brown, Chairman of the House Committee on Science, Space, and Technology. (*USA Today*, Jun 6/91; *NY Times*, Jun 6/91; NASA Release N91-42; *WSJ*, Jun 6/91; *CSM*, Jun 6/91; *UPI*, Jun 6/91)

- An article in the *Washington Post* commented that the House Appropriations Committee's decision to delete funding for NASA's Space Station from the 1992 budget represented a setback for a number of defense and space-related contractor companies that were counting on the project. (*W Post*, Jun 6/91)

- A *Christian Science Monitor* editorial commended NASA's work with regard to the Magellan spacecraft's survey of the surface of Venus. However, the editorial deplored the indecision and delays in the U.S. space program resulting from congressional ambivalence and stressed the need for the administration to achieve a sustainable program. (*CSM*, Jun 6/91)

- *AP* reported that researchers had found that the seeds, spores, and shrimp eggs flown on the Long Duration Exposure Facility for five years by NASA experienced some bizarre mutations but space radiation had a less serious effect on the life forms than expected. (*AP*, Jun 6/91)

- NASA Administrator Richard H. Truly issued a statement following action by the House of Representatives to continue the development of Space Station Freedom. Truly commended the bipartisan vote in the House, expressed his confidence that Freedom would win support in the Senate, and expressed his commitment to shape the final NASA FY 1992 budget in a way that balanced the various research and project areas. (NASA Release 91-88)

- *Nature* magazine contained an article by its associate editor David Lindley that was extremely laudatory of the findings of the Hubble Space Telescope, in spite of its flaws. He referred specifically to data obtained from the two spectrometers, designed to operate primarily at ultraviolet wavelengths to which the Earth's atmosphere is opaque. (*Nature*, Jun 6/91)

June 7: The media covered the House vote of 240 to 173 overturning the House Appropriations Committee action halting the Space Station program and authorizing \$1.9 billion to keep the program going. The role of the White House in pressuring Congress to support the project was stressed. Several articles also commented that the action was a boon to aerospace firms. The importance of the United States maintaining its space leadership and having a permanent presence in space, despite the high costs entailed, also were emphasized. (*P Inq*, Jun 7/91; *WSJ*, Jun 7/91; *NY Times*, Jun 7/91; *B Sun*, Jun 7/91; *W Times*, Jun 7/91; *USA Today*, Jun 7/91; *LA Times*, Jun 7/91; *W Post*, Jun 7/91; *C Trin*, Jun 7/91; *AP*, Jun 7/91; *UPI*, Jun 7/91; *Htsvl Tms*, Jun 7/91; *NY Times*, Jun 8/91; *Birmingham News*, Jun 10/91)

- Prior to the House vote, Thomas M. Donahue, Professor of Planetary Science at the University of Michigan, wrote an article published in the *Christian Science Monitor*. In it he sharply criticized NASA for making the Space Station its priority rather than scientific inquiry and urged Congress not to support the Space Station. *CSM*, Jun 7/91)

- The press reported that NASA was considering having two astronauts engage in a spacewalk to fix a cargo-door seal of Columbia that could prevent a safe return to Earth. The seal apparently shook loose during launch. It was later reported that NASA ground personnel determined the seal posed no re-entry problems so no spacewalk was needed. This allowed the astronauts more time to pursue their scientific experiments and medical research. (*P Inq*, Jun 7/91; *NY Times*, Jun 7/91; *W Post*, Jun 7/91; *W Times*, Jun 7/91; *LA Times*, Jun 7/91; *AP*, Jun 7/91; *UPI*, Jun 7/91; *B Sun*, Jun 8/91; *NY Times*, Jun 8/91; *W Post*, Jun 8/91; *AP*, Jun 8/91; *UPI*, Jun 8/91; *NY Times*, Jun 9/91; *W Post*, Jun 9/91; *C Trin*, Jun 10/91; *LA Times*, Jun 10/91)

- The *Baltimore Sun* reported that thanks to a NASA program to establish a super computer network among black universities, Morgan State University had received a super computer. The university planned to make the super

computer the foundation of a new Center for Applied Space Science and Engineering. (B Sun, Jun 7/91)

- NASA announced that as part of its Planetary Astronomy Program of the Office of Space Science and Applications, a team of radar astronomers had identified a near-Earth metal asteroid for the first time. Their discovery, observed from the giant Arecibo radar/radio telescope in Puerto Rico, was published in *Science* magazine. The object, called 1986 DA, was observed and analyzed by a team under Steven Ostro of NASA's Jet Propulsion Laboratory, Pasadena, California. The asteroid contains mostly iron but also eight percent nickel as well as some platinum-group metals and gold. (NASA Release 91-89; *NY Times*, Jun 11/91)

- NASA gave an update about the launching of Joust 1, a commercial sub-orbital rocket being launched from Cape Canaveral Air Force Station, Florida. Because of bad weather, the launch was postponed to June 9. (NASA Joust 1 Update, Jun 7/91)

June 8: According to the *Huntsville Times*, NASA's Advisory Council met following the House of Representatives vote to discuss plans for the Space Station and how to put the "A" for aeronautics back into NASA. Edward Starke Jr., chairman of the *ad hoc* committee on the High Speed Research Program reported on plans for a new supersonic jet to be used by the commercial aviation industry. (*Htsvl Tms*, Jun 8/91)

June 9: The *Huntsville Times* published a history of NASA in connection with its Marshall Space Flight Center and the Army Ballistic Missile Agency Development Operations Division in Huntsville. Reference was made to the early days of the Redstone Arsenal as well as to statistics of employment and various Shuttle launches. (*Htsvl Tms*, Jun 9/91)

June 10: Robert F. Sekerka, Dean of the College of Science at Carnegie-Mellon University in Pittsburgh and Chair of the Committee on Microgravity Research of the Space Studies Board, wrote an article in the *Wall Street Journal* sharply criticizing the appropriation for the Space Station. He questioned the purpose of the Space Station and its cost-effectiveness. (*WSJ*, Jun 10/91)

- Peter J. Wylie, professor of geology at the California Institute of Technology, commended NASA's mapping of Venus but stated that only 29 percent of the Earth's surface has been mapped in detail. He suggested that NASA's Mission to Planet Earth take the form of an integrated space-borne and ground-based mission that could map the remaining 71 percent of the surface beneath the ocean. (*LA Times*, Jun 10/91; *P Inq*, Jun 22/91)

- A space publication reported that NASA Administrator Richard Truly would forgo attendance at the 1991 Paris Air Show in order to remain in

Washington to keep close watch on the congressional fight to keep the Space Station appropriation in the budget. In an editorial in the same journal, it was stated that maintaining the Space Station "at the cost of nearly everything else NASA does would be a major mistake." Subsequently, an editorial in the *San Jose Mercury News* expressed similar concern that NASA's other important programs would be sacrificed for the sake of the Space Station. (*SP News*, Jun 10-16/91; *San Jose Mercury News*, Jun 11/91)

- Encore Computer Corporation filed an agency protest of a \$191 million award by NASA Johnson Space Center to IBM Corporation for a mainframe requirements contract. NASA officials were to meet with Encore representatives over the disagreement, which involved pricing information submitted. (*Federal Computer Week*, Jun 10/91)

- *Federal Computer Week* reported on NASA's plans to award contracts for up to 13,700 Unix-based work stations spanning seven classes. (*Federal Computer Week*, Jun 10/91)

June 11: According to the media, the Columbia astronauts were ahead of schedule on their experiments after spending 16- to 18-hour days working and planned to ease off and enjoy space more. On June 12 and 13, the press reported the continuing scientific experiments of the astronauts, culminating in efforts to fix two malfunctioning freezers in order to preserve experiment samples prior to final preparations for a landing on June 14. (*P Inq*, Jun 11/91; *NY Times*, Jun 11/91; *B Sun*, Jun 11/91; *W Post*, Jun 11/91; *USA Today*, Jun 11/91; UPI, Jun 11/91; *USA Today*, Jun 13/91; *W Post*, Jun 13/91; AP, Jun 13/91; UPI, Jun 13/91; *LA Times*, June 13/91; *P Inq*, Jun 14/91; *NY Times*, Jun 14/91; *W Post*, Jun 14/91; *W Times*, Jun 14/91; *B Sun*, Jun 14/91; *Fla Today*, Jun 14/91; AP, Jun 14/91; UPI, Jun 14/91)

- The *New York Times* carried a major article stating that, to shave costs, aerospace experts have broken some of the rules about specifications and testing, resulting in significant flaws. Unless NASA were given more generous funding so it could stop "corner cutting" compromises, more serious problems were likely to arise. Norman R. Augustine, head of Martin Marietta Corporation, was quoted with regard to the importance of testing that should not allow it to be affected by budget reduction. (*NY Times*, Jun 11/91)

- NASA Administrator Richard H. Truly issued a statement expressing his pleasure at being present with the Space Exploration Initiative and the work done by retired Air Force Lieutenant General Thomas S. Stafford and his Synthesis Group. He referred to past cooperation of NASA with these and other agencies and appreciation for innovative suggestions received from the Outreach Program efforts. Press comments on the Stafford committee report emphasized the controversial nature of some of its recommendations, such as

landing Americans on Mars by 2014 and obtaining metals, ceramics, and energy sources from the Moon and Mars. (NASA Release unnumbered; *LA Times*, Jun 12/91; *W Post*, Jun 14/91; *Huntsville News*, Jun 25/91)

- NASA announced that the application of its sensor technology led to the development of a portable fetal heart monitor by a Langley Research Center, Hampton, Virginia team, headed by Allan J. Zuckerwar. The marketing of this monitor was to be part of the NASA program to transfer the Agency's space age technology to the private sector. (NASA Release 91-90)

June 14: The press reported that NASA had staged a mock emergency landing in preparation for Columbia's touchdown at Edwards Air Force Base, California. (*USA Today*, Jun 14/91; AP, Jun 14/91)

- NASA announced that its Gamma Ray Observatory (GRO) was maneuvered to point at its first scientific target of opportunity, the sun, on June 7. Controllers at Goddard Space Flight Center, Greenbelt, Maryland, repositioned the observatory to gather data from two X-class solar flares. All four GRO instrument teams reported receiving good data on solar activity as a result. (NASA Release 91-91)

- The media covered the flawless touchdown of Shuttle Columbia on June 14. The Shuttle apparently suffered no major damage. After a night's sleep, four of the astronauts remained to undergo a series of medical and physical tests of their readjustment to gravity. Tests also were to be performed on the animals that traveled on Columbia. (UPI, Jun 14/91; *W Post*, Jun 15/91; *P Inq*, Jun 15/91; AP, Jun 15/91; UPI, Jun 15/91; *W Post*, Jun 16/91)

- NASA's next Shuttle mission is to be that of Atlantis, scheduled for launch in July to release a giant Tracking and Data Relay Satellite intended to link Shuttles and other low-orbiting spacecraft with the ground. Conrad Nagel, the NASA manager responsible for the launch preparation, raised the possibility that Atlantis might be launched earlier than July 25. (*Fla Today*, Jun 14/91; AP, Jun 15/91)

June 15: An editorial in the *Sarasota Herald-Tribune*, charged that NASA historically sought to cut corners in space as a result of underfunding, accepting the cheapest bids, and skipping safety checks. Putting engineers in charge and greater discipline were factors advocated. (*Sarasota Herald-Tribune*, Jun 15/91)

June 16: According to *Florida Today*, a group of Florida universities hoped to attract a five-year, \$5 million NASA grant to set up a commercial space development center. The center would focus on the commercial potential of advanced satellite communications technology. (*Fla Today*, Jun 16/91)

June 17: Astronaut Guion Bluford Jr., in a commencement speech at Drexel University's 100th anniversary, called for a new national commitment to "scientific literacy."

- A space journal commended Lieutenant General Thomas P. Stafford's Synthesis Group report for its role in separating the issues involved in the space exploration initiative. The editorial stated that now NASA must deliver with respect both to the Space Station and Mission to Planet Earth in order to convince Americans of the desirability of sending astronauts to Mars. (*AvWk*, Jun 17/91)

June 18: An article by Charles Krauthammer of *The New Republic* discussed arguments by foes of the Space Station and concluded that a bold new initiative in the form of a Moon base was a preferable next step in space. (*P Inq*, Jun 18/91)

- A lengthy account in the *New York Times* dealing with asteroids and the threat they posed to early life as well as the continuing possibility they might destroy Earth, referred to NASA's findings about early life forms based on a survey of impact craters on the moon. Several scientists' findings, discussed in the journal *Cell*, were also reported. The newspaper also published an article citing NASA's expenditure of somewhat less than \$1 million a year to search for Earth-crossing asteroids. NASA reportedly was also studying the feasibility of nudging asteroids aside and in this connection is to help sponsor the first International Conference on Near-Earth Asteroids. (*NYT*, Jun 18/91)

- According to the media, a small Prospector rocket, launched by Orbital Sciences Corporation of Fairfax, Virginia from Cape Canaveral Air Force Station, was blown up shortly after liftoff when it veered off course. This was Orbital's third attempt to launch the rocket for the University of Alabama in Huntsville, one of sixteen NASA Centers for the Commercial Development of Space. (*AP*, Jun 18/91; *NYT*, Jun 19/91; *USA Today*, Jun 19/91; *W Times*, Jun 19/91; *WSJ*, Jun 19/91; *B Sun*, Jun 19/91; *W Post*, Jun 19/91; *C Trin*, Jun 19/91; *LA Times*, Jun 19/91; *AP*, Jun 19/91; *UPI*, Jun 19/91; *H Chron*, Jun 20/91)

- *AP* reported that Japan planned to start developing a small unmanned Space Shuttle in 1992 and wanted to launch it by 2000. (*AP*, Jun 18/91)

- Lewis Schiff, program coordinator for NASA's High Alpha Technology Program, a cooperative research program at NASA's Ames, Langley, and Lewis Research Centers, announced that tests were underway on an F/A-18 fighter aircraft in the world's largest wind tunnel at Ames Research Center, Moffett Field, California. (NASA Release 91-92; *LA Times*, Jun 24/91)

June 19: The *Philadelphia Inquirer* reported that the National Weather Service's one weather satellite was nearing the end of its life. However,

NASA's next generation of satellites, one of which was to replace it, were three years behind schedule and \$500 million over budget. The atmospheric sensor of the new model reportedly tested poorly, but NASA planned to launch it nevertheless. AP quoted Joan A. Knauss, head of the National Oceanic and Atmospheric Administration (NOAA), as saying that meanwhile there were contingency plans to use both NOAA and Defense Department polar orbiting satellites and a European weather satellite to watch hurricanes in the Atlantic and Caribbean. (*P Inq*, Jun 19/91; AP, Jun 19/91)

- According to AP, the Shuttle Columbia left California on a piggyback jet ride to its home at Kennedy Space Center at Cape Canaveral, Florida. (AP, Jun 19/91)

- UPI reported that NASA managers reviewed plans to resume routine Shuttle landings at Kennedy Space Center. The unpredictability of Florida's coastal weather was at issue but it was felt that improvements NASA made in the Shuttle fleet were such that routine landings could now occur. (UPI, Jun 19/91)

- NASA's Goddard Space Flight Center, Greenbelt, Maryland, announced the selection of TRW, Inc., Redondo Beach, California, for one Total Ozone Mapping Spectrometer/Earth Probe Spacecraft (TOMS/EP). The contract was to provide for the design, development, fabrication, assembly, test, integration, launch, and post-launch support of the aircraft. (NASA Release C91-t)

- According to Reuters, as reported by the *Orlando Sentinel Star*, Jean-Marie Luton, director general of the European Space Agency, said at a news conference at the Paris Air Show that plans to launch a European Space Shuttle were proceeding despite cost overruns and technical problems. (*O Sen Star*, Jun 19/91)

June 20: The media reported NASA's announcement that henceforth the Kennedy Space Center in Florida would be a prime Shuttle landing site beginning with Atlantis' mission in July. However, because of Florida's temperamental weather, Shuttles were expected to return to California 60 percent of the time, according to Robert L. Crippen, Director of the Space Shuttle program. (AP, Jun 20/91; UPI, Jun 20/91; *NYT*, Jun 21/91; *B Sun*, Jun 21/91; *LA Times*, Jun 21/91)

- NASA announced it was scheduled to launch a \$3 million U.S. Air Force Radiation Experiment (REX) Scout rocket June 28 from Vandenberg Air Force Base, California. The REX was designed to test sophisticated communications in a high-radiation environment. (NASA Release 91-93)

- In an article written for the *Houston Post*, Republican Congressman Jack Fields strongly advocated Senate support of NASA's Space Station. Referring

to various uses of the Space Station program in the fields of medicine, industrial production, and basic science, he stressed the United States commitment to space exploration. (*H Post*, Jun 20/91)

- An article by S. Fred Singer, guest scholar at the Woodrow Wilson International Center for Scholars at the Smithsonian Institution, where he is completing a book on space policy, discussed the Space Station and the Stafford committee report. He advocated Martian Moon exploration as NASA's best solution. (*H Post*, Jun 20/91; *W Times*, Jun 25/91)

June 21: According to UPI, in a paper submitted to the journal *Science*, J. Fishman of NASA's Atmospheric Sciences Division and three other scientists, satellite monitoring data and ground-based pollution measurements indicated that air pollution from burning forests in tropical and subtropical Africa was wafting throughout the Southern Hemisphere, previously considered relatively clean compared to the heavily industrialized North. (UPI, Jun 21/91)

- NASA Administrator Richard H. Truly announced the selection of Darleen A. Druyun as Assistant Administrator for the Office of Procurement. The highest ranking woman career executive in Air Force contracting, she served previously as Principal Assistant Deputy Chief of Staff for Contracting, Headquarters Air Force Systems Command, Andrews Air Force Base, Maryland. (NASA Release 91-94)

- A *Journal of Commerce* editorial analyzed the factors relating to NASA and the Federal Communications Commission's licensing of a private communications consortium joint venture to develop a mobile satellite to provide clear voice communications in remote U.S. areas. In early 1991, the U.S. Court of Appeals for the District of Columbia challenged the FCC's authority to form the joint venture and license it, with the result that Congress cut NASA's proposed \$56 million contribution to the project. The companies feel cheated and the editorial advised that NASA should not be involved. (*Journal of Commerce*, Jun 21/91)

- According to AP, Space Shuttle Columbia returned home to Florida after a one-week trip from the West Coast. Reportedly, NASA would save \$1 million, in addition to travel time, by landing a Shuttle in Florida. (AP, June 21/91)

- The media reported engineers were studying a possible problem connected with a \$100 million Tracking and Data Relay Satellite (TDRS) to be launched by Shuttle Atlantis. The problem involved the motor that deployed a boom carrying a six-foot-wide antenna. The main TDRS antennas are folded for launch, but once the satellite is in orbit, the antenna booms rotate outward and the antennas open up like umbrellas. On June 24, NASA manager of the project Nicholas Chrissotimos, stated that the problem was resolved. (UPI, Jun 21/91; AP, Jun 22/91; *C Trin*, Jun 25/91)

June 23: According to UPI, reporting from Soviet television, a small satellite launched from Mir Space Station had not operated since it was lifted one week previously. (UPI, Jun 23/91)

June 24: The *Christian Science Monitor* carried a descriptive article about programs of the Howard B. Owens Science Center in Prince Georges County, Maryland. Schoolchildren spend two hours there simulating either landing on the moon or rendezvousing with Halley's Comet. The program is part of the Challenger Center for Space Science Education, founded by the families of astronauts killed in the Challenger disaster and to which NASA contributed. (CSM, Jun 24/91)

- NASA's Ames Research Center, Moffett Field, California, announced that it had selected BAMSI, Inc., Titusville, Florida, for a \$140 million preventive and remedial maintenance and services contract. (NASA Release C91-u)

- A space journal article discussed the likelihood of NASA's taking over Moffett Field in California in order to keep the Ames Research Center, which it shares with the Navy, going. Reportedly, NASA was considering such a move if the Defense Department closed the naval air station. The result would be operating a 1,000 acre airfield with two runways more than 8,000 feet long, the largest airfield complex operated by NASA. (AvWk, Jun 24/91)

- Two articles in a space journal described the software devised by NASA research pilot C. Gordon Fullerton that enabled control of a disabled aircraft with engine thrust alone. The journal reported that NASA funded McDonnell Aircraft research on implementing the software. (AvWk, Jun 24/91)

- NASA announced that the first mirror for its Advanced X-ray Astrophysics Facility (AXAF) space observatory was successfully completed at Hughes Danbury Optical System, Danbury, Connecticut, and shipped on June 12 to Eastman Kodak, Rochester, New York, for assembly. The AXAF observatory was to consist of six nested pairs of mirrors to obtain high resolution x-ray images of the universe. (NASA Release 91-95)

June 25: NASA's Goddard Space Flight Center, Greenbelt, Maryland, announced its selection of Fairchild Space, Germantown, Maryland, for a contract to provide engineering support services for the Space Technology Division. (NASA Release C91-w)

- NASA announced that preliminary data from its Total Ozone Mapping Spectrometer, an instrument on the Nimbus-7 satellite, indicated that a 4,800-mile-long cloud of sulfur dioxide was spread across the tropical

Northern Hemisphere from the major eruption of Mount Pinatubo volcano in the Philippines. (NASA Release 91-96; UPI, Jun 26/91)

- The media reported the successful efforts of two Soviet cosmonauts outside the Mir Space Station to replace a damaged antenna. (AP, Jun 25/91; UPI, Jun 25/91)

- According to the media, engineers waited out the storm at Cape Canaveral and then hauled Shuttle Atlantis to its launch pad. The Shuttle was scheduled to launch a Tracking and Data Relay Satellite to replace the Indian Ocean relay station. (UPI, Jun 25/91; *NY Times*, Jun 26/91; *W Times*, June 26/91; *USA Today*, Jun 26/91; *C Trin*, Jun 26/91)

June 26: NASA announced the selection of Taft Broadcasting Company of Houston for a contract providing television support services for the Johnson Space Center, Houston. (NASA Release C91-x)

June 27: NASA announced that the Infrared Astronomical Satellite (IRAS) had discovered a new, distant object that astronomers described as the most luminous object ever seen in the universe. Findings were published in the British science journal *Nature*, indicating it was a massive dust cloud that radiated 99 percent of its light in the infrared part of the spectrum. Astronomers speculated it might be a massive galaxy in the process of formation or a quasar in a massive galaxy. (NASA Release 91-98; *P Inq*, Jun 29/91)

- NASA announced information about the flight of Space Shuttle Atlantis scheduled for launch July 23 from Kennedy Space Center. The Shuttle was to deploy NASA's fourth Tracking and Data Relay Satellite (TDRS) into orbit to update the satellite tracking network. Details of the TDRS, its size, capacities, and capabilities, were provided. (NASA Release 91-97)

- The media reported that a private study by American scientists concluded that an international manned mission to Mars could be done within 21 years for less than \$60 billion. These figures represented faster and cheaper estimates than those of a proposed United States-only project. (*USA Today*, Jun 27/91; UPI, Jun 27/91; AP, Jun 27/91; *H Post*, Jun 30/91)

- In a letter to the editor, Lennard A. Fisk, Associate Administrator of NASA's Office of Space Science and Applications, and John N. Bahcall, professor of natural science at the Institute for Advanced Study at Princeton, declared that "There is strong national support for both a vigorous manned space program and a strong science program." Believing that both were essential, they pointed out that to maintain its space leadership position, the United States must continue such programs as the Advanced X-Ray Astrophysical Facility, missions to a comet and to Saturn, and the Earth Observing System. (*W Post*, Jun 27/91)

- UPI reported that General Dynamics concluded from its investigation that a piece of debris sucked into a pump apparently triggered an engine failure April 18 that sent a commercial Atlas-1 rocket tumbling out of control. The rocket was carrying a satellite for the Japan Broadcasting Corporation. (UPI, Jun 27/91)

- According to UPI, a jammed antenna crippling NASA's \$1.4 billion Galileo Jupiter probe might pop free after its support structure contracts in the cold of space. (UPI, Jun 27/91)

June 28: NASA announced that its Galileo spacecraft would turn and fire its on-board thrusters on July 2 to set its course for an encounter with the asteroid Gaspia in October 1991. This would be the first flyby of an asteroid. (NASA Release 91-99)

- James Head of Brown University, a geologist on Magellan's NASA science team, announced that the Magellan spacecraft that was mapping the surface of Venus with imaging radar, had discovered a lava flow that might represent a volcanic eruption similar to those currently occurring in Japan and the Philippines. (NASA Release 91-100)

- The *Washington Post* quoted John Knauss, head of the National Oceanic and Atmospheric Administration, which includes the National Weather Service, as saying that "We can no longer assume that a NASA-built satellite will serve our needs." The statement referred to NASA's plans to launch GOES-NEXT, the next generation of Geostationary Operational Environmental Satellites. NASA tests indicated that two of the main instruments to be used on the satellites, an imager and a temperature-humidity sensor called a sounder, were defective. UPI indicated that Knauss announced the appointment of a task force to consider alternative courses of action regarding a weather satellite, such as leasing a Japanese or European satellite. (*W Post*, Jun 28/91; UPI, Jun 28/91; *NY Times*, Jun 29/91; *Time*, Jul 1/91)

- NASA announced that astronaut Bryan D. O'Connor would leave NASA July 29 to become Commander of the Marine Air Detachment at the Naval Air Test Center, Patuxent River, Maryland. (NASA Release 91-101; UPI, Jun 28/91)

June 29: According to Tass, two Soviet cosmonauts in a long spacewalk installed two panels on the surface of Mir to study the generation and distribution of super-heavy nuclei in the galaxy as well as a set of detectors to measure streams and spectra of charged particles of space origin. (UPI, Jun 29/91)

- According to the *Washington Post*, as part of U.S.-Soviet discussions leading to a summit, was the possible exchange of American astronauts flying on Mir and Soviet cosmonauts being launched on a U.S. Space Shuttle. (*W Post*, Jun 29/91)

June 30: The *New York Times* reported that fuel cells, first developed for use in space in the 1960s, were being used increasingly in commercial plants. A fuel cell is a device that converts the energy of a fuel directly to electricity and heat, without combustion. The United States had developed an experimental plant in San Ramon, east of San Francisco, and other plants were considering use of the new technology. (*NYT*, Jun 30/91)

- Maryland Democratic Senator Barbara Mikulski, chair of the Senate Science Space and Technology subcommittee, visited the Space and Rocket Center in Huntsville and NASA's Space Camp for young people. According to the *Huntsville Times*, Mikulski strongly supported the Space Station and said "The space program excites our young people to become concerned about math and science." (*Htsvl Tms*, Jun 30/91)

July

July 1: NASA announced that, on June 29, its 114th Scout launch vehicle placed an Air Force Radiation Experiment (REX) into a 450 nautical mile polar orbit. The launch occurred from Vandenberg Air Force Base, California, and was delayed for one day by bad weather. (NASA Release 91-102)

- A number of NASA scientists participated in the International Conference on Near-Earth Asteroids held in San Juan Capistrano, California, jointly sponsored by NASA and The Planetary Society. At congressional request, a NASA committee headed by David Morrison, space science chief at Ames Research Center in Mountain View, was to recommend how to improve the search for asteroids. Another committee was to advise how best to divert threatening asteroids. At the end of the conference on July 3, a statement advocated construction of several sophisticated new telescopes to find all significant asteroids and learn if any were on a collision course with Earth. (AP, Jul 1/91; AP, Jul 4/91; *LA Times*, Jul 4/91; *P Inq*, Jul 6/91; *Oakland Tribune*, Jul 8/91)

- *Time* published an interview with NASA Administrator Richard Truly in which various questions were asked about the Space Station. Truly justified proposed expenditures by stressing the payoff in such areas as environmental control, life-support research, power generation, and health care technologies as well as the discoveries themselves. He also stated that Mission to Planet Earth was poorly understood but promised “unbelievable benefits.” (*Time*, Jul 1/91)

- In an article in the Science section, *Time* discussed the theory that a giant comet that struck the earth was responsible for killing off dinosaurs. In this connection, the findings of a team of scientists led by Charles Duller at NASA’s Ames Research Center were mentioned. From satellite photos of the Yucatan, the team discovered the semicircle that might indicate a huge buried crater of an asteroid. (*Time*, Jul 1/91)

- The *Huntsville Times* quoted the General Accounting Office as saying that contrary to earlier concerns, a survey revealed that potential retirements of skilled NASA scientists and engineers would not be a problem. (*Htsvl Tms*, Jul 1/91)

July 2: The media reported on NASA’s plans to install corrective lenses on the Hubble Space Telescope in order to correct the faulty lens and at the same time to make other repairs. Details remained to be announced. (AP, Jul 2/91; *NY Times*, Jul 3/91; *W Times*, Jul 3/91)

- NASA announced that as a result of the huge outpouring of volcanic material from Mount Pinatubo in the Philippines, a research team of NASA

atmospheric scientists was being sent to the West Indian island of Barbados to gather data to help evaluate the global atmospheric effects of this event. Several NASA scientists subsequently commented on Pinatubo's plume and its spreading. (NASA Release 91-103; *W Post*, Jul 8/91)

- According to the media, spacecraft Galileo successfully fired its thrusters to alter its course, enabling it to flyby the asteroid Gaspra on October 29. (AP, Jul 2/91; UPI, Jul 2/91; *USA Today*, Jul 3/91)

July 3: NASA announced that astronaut Michael L. Coats would retire from the Navy and leave NASA August 1 to become director of Advanced Programs and Technical Planning at Loral in Houston. (NASA Release 91-104; AP, Jul 3/91)

- NASA announced that its Lewis Research Center, Cleveland, had selected RMS Technologies, Inc., of Landover, Maryland, for a contract for the computing, communication, and network mission needs of the center. (NASA Release C91-y)

- Per Gloersen, a senior scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, was quoted by the media as reporting in the British publication *Nature* findings concerning the shrinking of the polar ice cover. Global warming might be the cause, but Gloersen said 30 years of records would be needed for a definite conclusion. (UPI, Jul 3/91; *B Sun*, Jul 4/91; *LA Times*, Jul 4/91; *W Post*, Jul 8/91)

- UPI reported the practice countdown of the crew of Shuttle Atlantis for its flight July 23. NASA announced that Atlantis would put NASA's fourth Tracking and Data Relay Satellite into orbit on its mission in order to update the satellite tracking network. (UPI, Jul 3/91; unnumbered NASA General Release, undated)

- According to the *Cleveland Plain Dealer*, the Ohio EPA ordered an investigation and cleanup of contamination at NASA's Lewis Research Center. NASA officials stated voluntary cleanup efforts were underway and Peter W. McCallum, NASA's chief of environmental safety, said most of the sites had been cleaned up or soon would be; he was confident no contamination was leaving NASA's property. (*Cleveland Plain Dealer*, Jul 3/91)

July 4: The media reported that the Air Force had launched an unmanned Delta rocket from Cape Canaveral on July 3. The rocket contained a \$65 million satellite that joined 10 advanced Global Positioning System spacecraft already circling the globe in order to assist military forces on the ground, at sea, and in the air to determine their location. (UPI, Jul 4/91; *W Times*, Jul 5/91)

July 5: According to the *Washington Times*, Orbital Science Corporation announced it planned to launch the state's first privately funded orbital flights from the NASA base on Wallops Island by 1993. Orbital was pressuring the governor of Virginia to make the area a tax-free foreign-trade zone, comparable to legislation that has declared Cape Canaveral, Florida, tax-free in order to reduce the launch cost. (*W Times*, Jul 5/91)

- NASA announced that Lewis Research Center, Cleveland, had selected the team of General Electric Corporation, Cincinnati, and United Technologies Pratt and Whitney Division, West Palm Beach, Florida, for a contract for propulsion materials to be used on a 21st century High Speed Civil Transport. (NASA Release C91-z)

- NASA announced that a 15-member delegation of Soviet space officials, headed by Oleg N. Shishkin, minister of General Machine Building, would be visiting NASA Headquarters and Space Centers from July 9 to 16. (NASA Release 91-105)

July 6: The press reported that NASA agreed on July 5 to seek new bids on the \$191 million mainframe computer contract awarded IBM but protested by the Fort Lauderdale, Florida-based Encore Computer Corporation. (*NY Times*, Jul 6/91; *H Chron*, Jul 6/91)

July 7: The *Antelope Valley Daily News* reported that NASA might be flying one of the Advanced Tactical Fighters, namely the F-23 prototype, about which it was negotiating with Northrop Corporation. The aircraft would be used for aeronautics research at NASA's Dryden Flight Research Facility at Edwards Air Force Base. (*Antelope Valley Daily News*, Jul 7/91)

July 8: PR Newswire reported that engineers from McDonnell Douglas Space Systems Company would meet with representatives of NASA and its international partners from July 8 to 25 to review changes to the basic design of Space Station Freedom. Discussion is to center on Work Package 2 dealing with such factors as the propulsion assembly, resource node design, external thermal control, data management, communication and tracking, extravehicular systems and guidance, and navigation and control systems. (PR Newswire, Jul 8/91)

- According to a space publication, NASA's cost estimate for its Advanced Solid Rocket Motor (ASRM) program had increased to about \$3 billion, and NASA formally announced that the main ASRM goal was to aid the construction of the Space Station. The ASRM was intended to launch an extra 8,000 pounds of Space Station equipment on each Shuttle flight carrying Space Station hardware. (*SP News*, Jul 8-14/91)

- The *Space Propulsion* newsletter commented on the report of the Stanford University professors who, together with Soviet aerospace engineers, projected that at a cost of \$60 billion (about one-eighth NASA's estimate) a joint venture using the Soviet Energia heavy-lift rocket could land humans on Mars by 2012. In contrast, the Stafford Synthesis Group estimated 2014 as the earliest date to reach Mars, using lunar bases established in the interim. Some civilian space experts found flaws in the Stanford study. In line with comments on the Stanford report, the *New York Times* featured a lengthy article on the designer of the Energia rockets, currently visiting New York and seeking a U.S. buyer for the rocket. (*SP News*, Jul 8-14/91; *NY Times*, Jul 9/91)
- NASA announced that spacecraft Ulysses had fired two small thrusters to set the final course for its early February 1992 rendezvous with Jupiter. Many of Ulysses' science experiments were expected to yield new data about Jupiter's magnetic field and particle environment. (NASA Release 91-106; *AP*, Jul 8/91; *P Inq*, Jul 9/91; *W Post*, Jul 9/91; *USA Today*, Jul 9/91; *W Times*, Jul 9/91)
- NASA announced it would resume active space physics experiments by conducting several chemical releases in July and August with the Combined Release and Radiation Effects Satellite. Barium vapor releases in the Caribbean area were involved. (NASA Release 91-107)
- The *New Republic* carried a seven-page article entitled "The Case Against NASA" by Gregg Easterbrook, contributing editor of *Newsweek* and the *Atlantic*. The author asserted that NASA needed to be "truly reformed" and outlined under 25 headings, ranging from "Boosters" to "What Is To Be Done?," the failures he perceived in NASA, together with some suggestions for improvement. (*New Republic*, Jul 8/91)
- The *Washington Post* carried an article about the difficulties Spacehab Inc. was having commercially. NASA said there was a need for its product: a 10-foot-long pressurized module that fits in the cargo area of the Space Shuttle, expanding the cramped living and storage quarters. Problems arose, however, over NASA's ability to cancel contracts unilaterally (which might occur if Congress in its annual appropriations cut NASA's funds) and Congress's ability to cut funds for Spacehab in spite of any commitments NASA made to it. The lengthy article reviews the history of Spacehab and its operations. (*W Post*, Jul 8/91)

July 9: NASA announced its Goddard Space Flight Center, Greenbelt, Maryland, would participate in two experiments to study the July 11 solar eclipse from the ground and from space. A new cryogenic instrument attached to NASA's Infrared Telescope Facility atop Mauna Kea, Hawaii, was to test a theory about the sun's atomic processes in its infrared regions. Also, an x-ray

telescope in a sounding rocket, to be launched from White Sands, New Mexico, was to study the solar corona. (NASA Release 91-108)

- ST Systems Corporation, Vienna, Virginia, announced its selection by NASA's Marshall Space Flight Center to provide support for the High Energy X-ray Telescope Sounding Rocket Program. (PR Newswire, Jul 9/91)
- The media reported that 14 major scientific organizations were joining forces to warn of the "excessive cost" of the planned \$30 million Space Station that would "threaten the vitality" of essential scientific research programs and imperil U.S. leadership in world technology. The organizations urged a "balanced" space program but did not call for the Space Station to be killed. (*LA Times*, Jul 9/91; *P Inq*, Jul 10/91; *W Post*, Jul 10/91; *NY Times*, Jul 10/91; *Science*, Jul 19/91)
- The *Wall Street Journal* criticized NASA's decision to drop a proposed instrument to detect environmental change, the High-Resolution Imaging Spectrometer, or HIRIS, and to substitute a Japanese instrument being offered NASA at no cost. The Japanese instrument to be built by Japan's Ministry of International Trade and Industry, is the Advanced Spaceborne Thermal Emission and Reflection Radiometer, or Aster, to detect minerals and geological formations that may contain oil. Criticism of the decision, which NASA said was based on HIRIS being too risky and too expensive, centered on the boost Aster would give Japanese technology as well as the Japanese oil industry and the lost U.S. ability to detect environmental change. (*WSJ*, Jul 9/91)

July 10: NASA announced that the second mission of the Pegasus air-launched space booster was scheduled for July 17. Pegasus was to be launched from below the wing of a NASA B-52 aircraft based at Ames-Dryden Flight Research Facility, Edwards, California. Pegasus was to carry seven small Defense Department satellites for the Defense Advanced Research Projects Agency and put them into low Earth orbit. (NASA Release N91-49)

- Former astronaut Thomas Stafford, head of the Synthesis Group, told Congress it would not require much start-up money to set the U.S. on a course to Mars in the next century. He said funds could come in savings from the Department of Defense and Department of Energy budgets. (AP, Jul 10/91)
- The *Huntsville Times* reported that volunteers in a water taste test at NASA's Marshall Space Flight Center had difficulty or were unable to distinguish recycled from regular water. The recycled water came from perspiration collected in a test chamber, and in which the salts, oils, and microorganisms were subsequently removed. The recycling process was designed to be used on the Space Station to minimize the need for additional water. (*Htsvl Tms*, Jul 10/91; *W Times*, Jul 19/91)

July 11: The media reported that on July 10 the Senate Appropriations subcommittee, despite the strong opposition of the scientific community, approved \$2.02 billion—the full amount requested by the Bush administration—to continue the Space Station project for one more year. Senator Barbara A. Mikulski, Democrat of Maryland, and Senator Jake Garn, Republic of Utah, were key supporters of the Space Station funding. The Space Station vote was at the cost of cuts and delays in separate satellite programs and unmanned space exploration. (*W Post*, Jul 11/91; *WSJ*, Jul 11/91; *W Times*, Jul 11/91; *USA Today*, Jul 11/91; *LA Times*, Jul 11/91; AP, Jul 11/91)

- According to the press, Senate budget leaders expressed concern over NASA's ability to launch the GOES-NEXT weather satellite in time to meet weather monitoring needs. They urged that the National Weather Service buy a \$100 million backup satellite, possibly obtaining one from Japan. NASA Administrator Richard Truly said NASA accepted responsibility for the delays and cost overruns in the construction of the new satellites. (*W Post*, Jul 11/91; *NY Times*, Jul 11/91; *C Trin*, Jul 11/91; AP, Jul 11/91; UPI, Jul 11/91)

- NASA announced that the U.S. and Spain had signed a space cooperation agreement providing for the use of Spanish bases and installations as alternative landing sites for the U.S. Space Shuttle. (NASA Release 91-109)

- NASA announced that it would display a new exhibit, "NASA: Expanding the Frontiers of Flight," at the 39th Annual Experimental Aircraft Association International Fly-In Convention, July 26 - August 1, in Oshkosh, Wisconsin. (NASA Release 91-110)

- The press quoted the official Notimex news agency as reporting that the rocket that was to provide data about the sun during the total eclipse on July 11 failed to send back any data. The project was jointly sponsored by the Florida Institute of Technology and the National Autonomous University of Mexico. (AP, Jul 11/91; *B Sun*, Jul 12/91)

- On the total solar eclipse, the media reported on the "spectacular" nature for some viewers but the confusing nature for some telescopes. Drake Deming of NASA's Goddard Space Flight Center in Greenbelt said his team was up most of the night but succeeded in time to solve a problem with one of their instruments. (AP, Jul 11/91; UPI, Jul 11/91; *W Post*, Jul 12/91)

- According to AP, the National Research Council endorsed NASA's planned Earth Observation System, which it called "the largest single component of the most ambitious scientific enterprise ever undertaken." The Council stated it had some concern over the program's management, however, and urged the earth science and space research community to keep a close eye on the program. (AP, Jul 11/91; *W Post*, Jul 13/91)

- The wire services reported that NASA managers reaffirmed their previous decision to resume routine Florida Shuttle landings. This occurred prior to the start of a two-day review to clear Atlantis for blastoff around July 23. (UPI, Jul 11/91; AP, Jul 12/91)

- The *Huntsville Times* reported that Boeing's top space scientist, Harvey Willenberg, who had returned from a trip to the Soviet Union, was convinced from the Mir experiments he saw that NASA needed to build Space Station Freedom. The experiments in the area of microgravity were especially impressive. (*Htsvl Tms*, Jul 11/91)

July 12: The media gave a detailed report on plagiarism involving students of professor Walter Frost, and a private for-profit research firm of Frost's that did work for NASA. NASA's Office of Inspector General was currently investigating the apparent extensive plagiarism, which involved at least one NASA staff member. (*WSJ*, Jul 12/91; AP, Jul 12/91; *Htsvl Tms*, Jul 14/91; *WSJ*, Jul 15/91; *NYT*, Jul 15/91; AP, Jul 15/91; AP, Jul 18/91; *W Post*, Jul 22/91; *Htsvl Tms*, Jul 24/91)

- McDonnell Douglas Space Systems Company announced it has teamed up with Japanese architectural and engineering firm Shimizu Corporation to develop space exploration technologies for the proposed U.S. lunar/Mars initiative. Each company was to fund its own research, which included applying solar energy on the lunar surface to process materials into useful resources such as oxygen and creating closed system that would recycle most of the products needed for a lunar base or long-term expedition to Mars. (*WSJ*, Jul 12/91; *LA Times*, Jul 12/91)

- NASA announced that July 23 would be the launch date for Space Shuttle Atlantis, which was to deploy the fifth Tracking and Data Relay Satellite. (NASA STS-43 Launch Advisory)

July 13: An article in *Congressional Quarterly* described the careful trimming of various programs performed by Senator Barbara Mikulski in order to provide sufficient funds for the Space Station. (*Congressional Quarterly*, Jul 13/91)

July 14: *Parade Magazine* contained a feature article on Barbara Morgan, who following the death of Christa McAuliffe in the Challenger disaster, was her designated successor as NASA's teacher in space. NASA Administrator Richard Truly was quoted as saying that after NASA's annual review of the subject, it was determined that it was not yet appropriate to send another teacher on the Shuttle although it was only a matter of time. Morgan stated she recognized the risks of space flight but was nevertheless eager to go ahead with a flight mission. (*Parade*, Jul 14/91)

- According to the *New York Times*, the Space Studies Board of the National Research Council recommended that NASA move quickly to develop and

deploy a system of Earth-monitoring satellites with the intention of studying climate. The proposed Earth Observing System called for six large, heavily instrumented orbiting platforms and smaller supplemental satellites, to cost \$30 billion over the next 30 years. (NYT, Jul 14/91)

July 15: NASA announced that the last of three SR-71 aircraft, loaned to NASA by the U.S. Air Force, was scheduled to arrive at the Ames-Dryden Flight Research Facility, Edwards, California, in late July. The *Antelope Valley Press* earlier reported the successful check flight of the Blackbird on July 10, prior to delivery to the NASA facility. The "Blackbirds" were to be used for high-speed, high altitude research in such areas as aerodynamics, propulsion, structures, and thermal protection materials. (NASA Release 91-111; *Antelope Valley Press*, Jul 11/91)

July 16: An article in the *Washington Post* pointed out NASA's policy of spreading out its contracts for the Space Station and other space projects among numerous states, which helped gain the support of congressional figures for NASA funding. (*W Post*, Jul 16/91)

- NASA announced that the Aviation Safety Reporting System (ASRS), which it manages for the Federal Aviation Administration, had prevented many air accidents and saved lives over the past 15 years. ASRS also identified safety issues for the aviation community and released research papers on aviation safety. FAA and NASA celebrated the 15-year anniversary of the program. (NASA Release 91-112; *Inside DOT*, Jul 25/91)

- NASA announced some of the results of its Long Duration Exposure Facility (LDEF), built by NASA's Langley Research Center, Hampton, Virginia. The LDEF was in a space environment from April 1984 to January 1990, with various materials, samples, and experiments on board. The 57 science and technology experiments gathered data on space radiation, atomic oxygen, meteoroids, contamination, space debris, space systems, and life sciences. Implications of LDEF results were being used in the design of lunar bases and Mars-bound aircraft. (NASA Release 91-113)

- According to UPI, a French Ariane rocket successfully boosted the first in a new series of advanced European environmental remote sensing satellites into orbit from the European Space Agency's jungle complex on South America's northern coast. The satellite, with a three-year life, had a radar system and other equipment to study Earth's oceans, ice packs, and land areas in great detail. (UPI, Jul 16/91; *P Inq*, Jul 18/91)

- AP reported that the Council of Engineers and Scientists Organization, whose member unions represent 80,000 scientists, engineers, technical, and professional staff sent a letter to each senator endorsing the Space Station. (AP, Jul 16/91)

- The *Los Angeles Times* quoted National Hurricane Center Director Robert C. Sheets as being concerned about the "precarious situation" with regard to hurricane forecasting. The GOES-7, the only U.S. weather satellite in orbit, was nearing the end of its five-year life expectancy and no replacement was available in the near future. Among possibilities were buying a satellite from Japanese or European makers. (*LA Times*, Jul 16/91)

- Sam F. Iacobellis, executive vice president and chief operating officer of Rockwell International Corporation, wrote a guest column stressing the importance of the Space Station to manned flight and the opportunity it provided not only for space leadership but also for the development of weightless materials sciences and biotechnology. (*Fla Today*, Jul 16/91)

July 17: The media reported a problem with an electronic component in Space Shuttle Atlantis but it was not expected to delay the launch. However, another power supply problem with the data processor might cause difficulties. (AP, Jul 17/91; UPI, Jul 17/91; *USA Today*, Jul 17/91)

- NASA announced a contract with Thiokol Corporation of Ogden, Utah, to manufacture 68 additional flight sets (136 motors) of redesigned Solid Rocket Motors and six additional motors for flight support for the Space Shuttle. (NASA Release C91-bb)

- According to UPI, an Orbital Sciences Corporation winged Pegasus rocket, carrying seven Defense Advanced Research Projects Agency "Microsat" research satellites, was launched on July 16 from a B-52 jet. However, controllers lost track of the payload after a possible malfunction. On July 18, Orbital Sciences heard signals from space and learned that the satellites were functioning but had entered a flawed orbit, limiting their lives to less than three years but sufficient to test a new military communications system. (UPI, Jul 17/91; *USA Today*, Jul 18/91; *WSJ*, Jul 18/91; *W Times*, Jul 18/91; *LA Times*, Jul 18/91; AP, Jul 18/91; *W Post*, Jul 19/91; *USA Today*, Jul 19/91; *P Inq*, Jul 19/91; *W Times*, Jul 19/91; *LA Times*, Jul 19/91)

July 18: The Senate on July 17 voted 64 to 35 to approve President Bush's \$2.03 billion request for the Space Station in the new fiscal year, \$100 million more than the House appropriated. (*W Post*, Jul 18/91; *W Times*, Jul 18/91; *LA Times*, Jul 18/91; AP, Jul 18/91; UPI, Jul 18/91)

- AP cited a NASA statement that despite engineers cooling and shrinking of spacecraft Galileo's stuck main antenna, the antenna remained stuck, threatening the ultimate exploration of Jupiter. (AP, Jul 18/91)

- The media reported an article in the journal *Science*, indicating that despite reports of global warming and African drought, the Sahara desert shrank

markedly since 1984, following a substantial expansion over the preceding four years. Two NASA scientists, Compton J. Tucker and William W. Newcomb, at NASA's Laboratory for Terrestrial Physics in Greenbelt, Maryland, and Harold E. Dregne of Texas Tech University's International Center for Arid and Semi-Arid Land Studies, conducted the research. Satellite measurements of vegetation on the ground were used to calculate the extent of the desert. (AP, Jul 18/91; NASA Release 91-114; *W Post*, Jul 21/91; *P Inq*, Jul 22/91; *LA Times*, Jul 22/91)

- UPI quoted *Krasnaya Zvezda* (Red Star), the official Soviet armed forces daily, as saying that the Soviet Union would cancel one manned space mission, launch another without a flight engineer, and leave a cosmonaut on the Mir Space Station beyond his planned six-month stay to save money. (UPI, Jul 18/91)

July 19: According to the wire services, discovery of trouble in a circuit used to separate the orbiter from the external fuel tank would delay the launch of Atlantis until July 24. (AP, Jul 19/91; UPI, Jul 19/91)

July 20: AP quoted Guy Brasseur, director of the atmospheric chemistry division at the National Center for Atmospheric Research in Boulder, Colorado, as stating that his research indicated the eruption of Mount Pinatubo could lead to reduced levels of protective ozone over North America and Europe in the winter of 1991-92 and the summer of 1992, possibly increasing the risk of skin cancer. Richard Stolarski, ozone researcher at NASA's Goddard Space Flight Center in Greenbelt, Maryland, said the projections were plausible but based on ozone depletion from El Chichon, a Mexican volcano that erupted in 1982, he thought there would be less ozone depletion than predicted. (*LA Times*, Jul 20/91; *P Inq*, Jul 20/91)

July 21: The press reported that NASA began its countdown for the launch of Atlantis, now postponed until July 24. (AP, Jul 21/91; *W Times*, Jul 22/91; *USA Today*, Jul 22/91; UPI, Jul 22/91)

July 22: NASA announced that seven of its sounding rockets would be part of an international campaign to study polar Noctilucent Clouds, the highest and coldest clouds on Earth, from Kiruna, Sweden, July 25 through August 12, 1991. (NASA Release 91-115)

- The media covered the final countdown preparations of the astronauts for the scheduled launch of Atlantis on July 24. Mission managers were satisfied with the completion of all necessary repairs. Then a storm on July 23 threatened to delay the blastoff, followed by the discovery early the morning of July 24 of trouble with a critical main engine computer. The discovery forced launch cancellation and postponement of the flight by at least one week to

install a new unit. UPI reported on repair efforts and attempts to discover the source of the problem. (AP, Jul 22/91; C Trin, Jul 22/91; LA Times, Jul 22/91; AP, Jul 23/91; UPI, Jul 23/91; NY Times, Jul 24/91; USA Today, Jul 24/91; W Post, Jul 24/91; W Times, Jul 24/91; AP, Jul 24/91; LA Times, Jul 24/91; CSM, Jul 24/91; UPI, Jul 24/91; W Post, Jul 25/91; P Inq, Jul 25/91; W Times, Jul 25/91; NY Times, Jul 25/91; AP, 25 Jul/91; UPI, 25 Jul 91)

- The *Huntsville Times* quoted *Aerospace America* as saying that Soviet officials confirmed reports that the Soviet military was preparing a manned space fighter with a crew of two to use against the U.S. Space Shuttle. The story cited a visit by General Dynamics technology analyst Richard Ward with Soviet designers. (*Htsvl Tms*, Jul 22/91)

July 23: NASA announced that its In-Space Technology Experiments Program would pass a major milestone when the Tank Pressure Control Experiment would go into orbit aboard Atlantis. Transfer and control of very cold (cryogenic) fluids in microgravity is critical to plans for several future U.S. space efforts. This experiment was to demonstrate how cryogenic storage tank pressures could be controlled. (NASA Release 91-116)

- Members of NASA's Project Viking, the group that put the first two space-ships on Mars 15 years previously, gathered at the Langley Research Center to commemorate that event on July 20, according to the *Washington Times*. (*W Times*, Jul 23/91)

- NASA announced the selection of Cortez III Service Corporation, Alamogordo, New Mexico, to provide institutional and programmatic support services for Space Station Freedom Program and Operations Office, Reston, Virginia. (NASA Release C91-cc)

July 24: RMS Technologies, Inc., Marlton, Pennsylvania, announced it had received a contract from NASA to provide operational support for workstations, other computers, and peripheral equipment at NASA's Lewis Research Center. (*P Inq*, Jul 24/91)

July 25: Vice President Dan Quayle, speaking as chairman of the National Space Council, said the U.S. would not buy or build more Space Shuttle orbiters. It is to continue to use the four existing orbiters into the next century but planned to develop a new family of rockets to replace the current fleet of unmanned vehicles. NASA Administrator Richard H. Truly said he helped devise the policy's wording and was "totally in support" of it. (*P Inq*, Jul 25/91; *W Post*, Jul 25/91; *B Sun*, Jul 25/91; *W Times*, Jul 25/91; *USA Today*, Jul 25/91; *WSJ*, Jul 25/91; *NY Times*, Jul 25/91; *Washington Technology*, Jul 25/91; *Htsvl Tms*, Jul 26/91; *Peninsula Times Tribune*, Jul 30/91 quoting *San Diego Tribune*; *B Sun*, Jul 31/91)

- The media reported on hearings of the House Committee on Science, Space, and Technology regarding the U.S. weather satellite. The General Accounting Office (GAO) found that the program for a new satellite, GOES-NEXT, was more than three years behind schedule and costs more than doubled because of mismanagement by NASA and the National Oceanic and Atmospheric Administration, and poor workmanship by contractors. The GAO report considered the problem originated when NASA neglected to have a critical engineering review of the feasibility of the program's objectives at the beginning of the project. (UPI, Jul 25/91; AP, Jul 25/91; *NY Times*, Jul 26/91)
- According to the *Los Angeles Times*, an Air Force-funded research center in El Segundo, California, was to begin in the fall to study the effect of rocket launches on the Earth's fragile ozone shield. Aerospace Corporation planned to investigate the role of solid rocket fuel combustion in the destruction of the ozone. These studies would supplement studies of ozone depletion done by NASA and would likely influence the types of fuels to be used in the National Launch System, a new generation of rockets scheduled for use after the year 2000. (*LA Times*, Jul 25/91)
- NASA announced that the Goddard Space Flight Center's Energetic Gamma Ray Experiment Telescope (EGRET), an instrument aboard NASA's Gamma Ray Observatory, had detected "the most distant and by far, the most luminous gamma-ray source ever seen." The EGRET team, led by Carl Fichtel, reported to the International Astronomical Union, Cambridge, Massachusetts, that a source of intense gamma radiation was detected between June 15 and June 28. The source was identified as the variable Quasar 3C279, located in the constellation Virgo. (NASA Release 91-117; *W Post*, Jul 29/91)
- NASA announced that a developmental Space Shuttle main engine sustained extensive internal damage while it was undergoing ground testing July 24 at NASA's Stennis Space Center, near Bay St. Louis, Mississippi. The engine differed from engines used in Shuttle flights. (NASA Release 91-118) July 26: NASA Administrator Richard H. Truly and Secretary of Energy James D. Watkins signed an interagency agreement on cooperation in areas relating to space isotope power. The agreement updated an earlier 1965 pact and delineated authorities of NASA and DOE on research, technology development, design, production, delivery, spacecraft integration, and launch support for radioisotope power systems. (NASA Release 91-119)
- NASA announced its release of new Magellan radar images of Venus representing coverage of 90 percent of the planet. The images highlighted the continuing volcanism and tectonism on Venus. (NASA Release 91-120; AP, Jul 27/91; *C Trin*, Jul 28/91)

July 28: The *Chicago Tribune* reported that Northwestern University scientists had discovered a process called sputtering that can coat hardened steel with titanium nitride films a few microns thick and double its hardness. The computer-controlled system was built for Northwestern's Basic Industrial Research Laboratory (BIRL) in a project that also involved funds from NASA and the Department of Energy. (C *Trin*, Jul 28/91)

July 30: The media covered NASA's go-ahead to proceed toward launch of Atlantis on August 1. The countdown began on July 29. (NASA STS-43 Launch Advisory; *P Inq*, Jul 30/91; *W Times*, Jul 30/91; *NY Times*, Jul 30/91; *USA Today*, Jul 30/91; UPI, Jul 30/91; *P Inq*, Jul 31/91; UPI, Jul 31/91; C *Trin*, Jul 31/91)

- The *New York Times* reported on the work of W.C. Wolverton, who formerly worked for NASA in research on plants that help clean indoor air. He left NASA to establish his own firm to research the use of houseplants in countering air pollution. Wolverton indicated that NASA was continuing its research in this area. (*NY Times*, Jul 30/91)

July 31: NASA announced that contrary to a news report that appeared, NASA was not planning a mission to visit the Hubble Space Telescope any earlier than late 1993. The science community had discussed this possibility because of some observed erratic behavior of the Hubble in one of the maneuvering gyros. Alternative servicing strategies were being evaluated. The announcement contradicted a *Washington Post* article. (NASA Release 91-121; *W Post*, Jul 31/91; AP, Jul 31/91; UPI, Jul 31/91; *B Sun*, Aug 1/91; *P Inq*, Aug 1/91; *USA Today*, Aug 1/91)

- According to AP, the House subcommittee on Science, Space, and Technology planned to examine NASA's "midlife crisis," referring to the Agency's "management failures" and "loss of leadership." The report mentioned NASA's recent series of problems with the Hubble Space Telescope, the GOES weather satellite, the postponements in the Space Shuttle launch, and the Galileo space probe's jammed antenna. (AP, Jul 31/91)

- NASA announced that as part of the agreement between Presidents Bush and Gorbachev during the July 30-31 Summit in Moscow, the U.S. and the Soviet Union had agreed to expand space cooperation. This is to consist of flying a U.S. astronaut on a long-duration Soviet Space Station Mir mission and a Soviet cosmonaut on a U.S. Space Shuttle mission, increasing cooperation in monitoring the global environment from space, and initiating annual consultations between the two governments on civil space issues. (NASA Release 91-122; *P Inq*, Aug 1/91; *NY Times*, Aug 1/91; AP, Aug 1/91; *W Post*, Aug 1/91)

- A column by Robert C. Cowen cited variances in figures for global warming among NASA's Marshall Space Flight Center and the University of

Alabama at Huntsville from those of NASA's Goddard Institute for Space Studies in New York, the Climate Research Unit of East Anglia in England, and the Soviet Union's Hydrometeorological Scientific Research Center. According to the British and the Goddard Institute, 1990 was the warmest year on record globally but according to the Marshall Center, using different data, the hottest years in descending order were 1987, 1988, 1983, and 1990. (CSM, Jul 31/91; *B Sun*, Aug 1/91)

August

August: The publication *Government Executive* carried a feature article on NASA by Mark L. Goldstein entitled "Lost in Space." Goldstein summarized NASA funding and projects as well as its contracting. A table of 1990 contract awards lists the 30 principal contractors in order of rank and the amounts of their contracts, Rockwell International being the largest, followed by Lockheed. (*Government Executive*, Aug/91)

August 2: The scheduled launch of Atlantis on August 1 was delayed by a false alarm over a pressure valve and then by bad weather, the media reported. The launch was rescheduled for August 2. The astronauts' first task after takeoff was to launch the \$120 million Tracking and Data Relay Satellite, which was done successfully. Various onboard experiments were begun, together with some medical research experiments designed to test the effects of weightlessness. (*B Sun*, Aug 2/91; *USA Today*, Aug 2/91; *NY Times*, Aug 2/91; *AP*, Aug 2/91; *UPI*, Aug 2/91; *P Inq*, Aug 3/91; *NY Times*, Aug 3/91; *W Post*, Aug 3/91; *AP*, Aug 3/91; *UPI*, Aug 3/91; *W Post*, Aug 4/91; *NY Times*, Aug 4/91; *UPI*, Aug 4/91; *C Trib*, Aug 4/91; *B Sun*, Aug 5/91; *W Times*, Aug 5/91; *USA Today*, Aug 5/91; *P Inq*, Aug 5/91; *C Trib*, Aug 5/91; *LA Times*, Aug 5/91; *AP*, Aug 5/91; *UPI*, Aug 5/91)

- The press reported that the subcommittee on investigations and oversight of the House Committee on Science, Space, and Technology on August 1 examined NASA's functioning at a hearing entitled "NASA's Midlife Crisis." The chairman of the subcommittee, Howard Wolpe, Democrat of Michigan, cited the need for NASA to be a "prudent steward" and expressed a lack of confidence in NASA's ability to carry out its mission. Various industry representatives testified about NASA's operations and its contracting. NASA inspector general Bill D. Colvin said NASA had failed to keep a sharp eye on its programs, operations, and contractors, resulting in the waste of millions of dollars. (*W Post*, Aug 2/91; *B Sun*, Aug 2/91; *LA Times*, Aug 2/91; *AP*, Aug 2/91; *AvWk*, Aug 5/91)

August 3: An article about the colorful sunsets along the California coast referred to the effects of the eruption of Mount Pinatubo. According to Francisco Valero, chief of atmospheric research at NASA's Ames Research Center in Mountain View, California, Pinatubo probably spewed some 16 million tons of sulfur dioxide into the atmosphere, causing the spectacular sunsets. However, the aftereffects were that the cloud of sulfuric acid droplets could further accelerate the depletion of the ozone layer. (*P Inq*, Aug 3/91)

August 4: According to AP, antennas on six major spacecraft had malfunctioned during the preceding 17 months, threatening the crucial flow of infor-

mation from missions. Accordingly engineers conducted extra reviews of antennas on Atlantis. Henry Hoffman, guidance and control chief at NASA's Goddard Space Flight Center, said part of the problem was that antennas were increasingly large and complex, requiring folding for launch and problems arose when they were extended or unfolded. (AP, Aug 4/91)

- Gregg Easterbrook wrote an article entitled "Space Agency Lost its Edge in Technology Long Ago," in which he criticized NASA's technology on the Atlantis. As an example, the computer system had only one megabyte of random-access memory in contrast to laptop computers available at Radio Shack with two to four megabytes of memory. The author attributed much of the loss of a technological cutting edge to overstaffing and government paperwork requirements as opposed to the rapid and creative activity of NASA's early days. (LA Times, Aug 4/91)

August 5: NASA announced a number of contract arrangements. A contract extension was awarded to Vitro Corporation of Silver Spring, Maryland, to continue safety and support services at NASA Headquarters in Washington, D.C. NASA further selected Nichols Research Corporation, Huntsville, Alabama, and BDM Federal, Inc., McLean, Virginia, to compete for a support contract for the Earth Observing System Program Office in Washington. In addition, NASA's Johnson Space Center, Houston, contracted with Johnson Controls, Inc., Cape Canaveral, Florida to provide maintenance and operational services at Johnson. (NASA Releases C91-dd, C91-ee, C91-ff)

- NASA announced that on July 15 at its Ames-Dryden Flight Research Facility, Edwards, California, NASA's F/A-18 High-Alpha Research Vehicle maneuvered in flight for the first time using a specially designed thrust vectoring system. Such research flights were to continue over the next two years and were designed to make future jet fighters safer. (NASA Release 91-123)

- An editorial in *Aviation Week and Space Technology*, commended U.S. government-sponsored educational displays at the Experimental Aircraft Association's exhibition at Oshkosh, Wisconsin. It specifically complimented NASA's Space Station and Space Shuttle displays and astronaut Steve Nagel's presentations as effectively communicating U.S. space leadership. (AvWk, Aug 5/91)

August 6: Extensive media coverage of experiments performed by the astronauts aboard Atlantis continued. Among such experiments were the testing of equipment to be used on the Space Station, such as fiber optic cables to transmit signals, a cooling system, and modifications in controls for computers. Another experiment involved lighting a small fire to learn how flames propagate in the absence of gravity. In addition, a NASA optometrist tested

eye drops on himself and astronauts performed treadmill tests and blood experiments. Astronauts commented on the large amount of haze around the Earth, possibly from the Kuwaiti oil field fires or from the volcanic eruptions of Mount Pinatubo. (*P Inq*, Aug 6/91; *NY Times*, Aug 6/91; *W Times*, Aug 6/91; *W Post*, Aug 6/91; *USA Today*, Aug 6/91; AP, Aug 6/91; UPI, Aug 6/91; *P Inq*, Aug 7/91; *W Times*, Aug 7/91; *W Post*, Aug 7/91; *USA Today*, Aug 7/91; AP, Aug 7/91; UPI, Aug 7/91; *P Inq*, Aug 8/91; *NY Times*, Aug 8/91; *W Post*, Aug 8/91; *USA Today*, Aug 8/91; CSM, Aug 8/91; AP, Aug 8/91; UPI, Aug 8/91; *B Sun*, Aug 9/91; *W Times*, Aug 9/91; AP, Aug 9/91; UPI, Aug 9/91)

- NASA announced that the Johnson Space Center, Houston, had made a supplemental agreement to the contract with McDonnell Douglas Space Systems Company, Huntington Beach, California. The modification included the changes made in Space Station Freedom Program review activities. (NASA Release 91-124)

- Randy Berridge of the Astronauts Memorial Foundation stated that the memorial to American astronauts killed in the line of duty was closed for inspections after strange noises were heard coming from the monument. After engineers checked the structure, it reopened on August 17. Subsequently, Representative Vernon Peeples, chairman of the Florida House Transportation Committee, questioned whether money for the monument had been misused. (UPI, Aug 6/91; *P Inq*, Aug 7/91; *W Post*, Aug 7/91; *USA Today*, Aug 7/91; *LA Times*, Aug 19/91; *P Inq*, Aug 20/91)

August 7: According to AP, two congressmen, Howard Wolpe, Democrat of Michigan, and Sherwood Boehlert, Republican of New York, urged that the United States “borrow” or buy a GMS-5 weather satellite being built by the U.S. firm Hughes for Japan. This would allow NASA time to fix the problems with the Geostationary Operational Environmental Satellite (GOES-NEXT). In connection with GOES, *Washington Technology* reported in some detail on the “troubled history” of the weather satellite and its contractors and congressional criticism of the program. The *Christian Science Monitor* reported on lessons learned from GOES-Next, including not to cut corners in developing sophisticated technology and the importance of sharing weather data globally. (AP, Aug 7/91; *Washington Technology*, Aug 8/91; CSM, Aug 20/91; *H Post*, Aug 21/91)

- NASA announced that results from a NASA flight test program showed that new sensor technology might provide airline flight crews with advance warning of “microbursts” that sometimes harbored potentially dangerous windshears. (NASA Release 91-125)

August 8: The media reported a study contained in the British journal *Nature*, written by Brian Toon, senior researcher at NASA's Ames Research Center in

Moffett Field, California, Christopher P. McKay, who also worked at Ames, and James F. Kasting, associate professor of geosciences at Pennsylvania State University. The authors concluded it would be relatively easy to alter Mars' atmosphere to make it suitable for plants. Making the planet fit for people, however, would take about 100,000 years. (*P Inq*, Aug 8/91; *USA Today*, Aug 8/91; *C Trin*, Aug 8/91; *LA Times*, Aug 8/91; UPI, Aug 8/91)

- NASA announced the signing of an agreement in Buenos Aires by Vice President Dan Quayle and Argentine President Carlos Menem on cooperation in the civil uses of space. A framework for future cooperative space projects between NASA and the newly created Argentine National Commission on Space Activities was established. (NASA Release 91-126)

- *Washington Technology* carried two articles on NASA's Earth Observing System (EOS). The first discussed the possibility of the EOS instrument payload being divided among three launch vehicles while still maintaining its "simultaneity." The second quoted NASA officials Lennard Fisk and Shelby Tilford as addressing the EOS Engineering Review Panel in La Jolla, California. They said NASA had devised a restructured plan to remove several of the EOS satellite sensors and replace them with "ballast" of thousands of pounds of lead to maintain payload balance. (*Washington Technology*, Aug 8/91)

August 9: The *Washington Post* reported on growing congressional hesitations about supporting NASA's Mission to Planet Earth program. Legislators recently realized the mission would cost almost as much as the Space Station although it would carry only robots, not people. The Senate recommended cutting \$50 million from the administration's 1992 Earth Observing System (EOS) budget request. The EOS, which would involve a series of large, sophisticated satellites, is to be the centerpiece of the mission. The House cut \$145 million from the proposed budget request. Meanwhile, a panel of aerospace experts is reviewing the EOS engineering design and posing difficult questions. (*W Post*, Aug 9/91)

- According to the *Washington Times*, Eosat, based in Lanham, Maryland, a joint venture of Hughes Aircraft Company and General Electric Company, defeated its competitor and gained the contract for distributing images from the new Soviet Almaz satellite. (*W Times*, Aug 9/91)

- The *New York Times* cited a report by Jean O. Dickey, a geodesist at NASA's Jet Propulsion Laboratory in Pasadena, California, and Raymond Hide, a geophysicist at Oxford, published in the journal *Science*. They analyzed the rotation of the earth, which is fitfully and almost imperceptibly slowing. More accurate measurements than in the past were possible by bouncing laser signals off quartz reflectors left on the moon by Apollo astronauts. (*NY Times*, Aug 9/91)

- Several media articles dealt with attempts to rescue spacecraft Galileo's mission. The *Los Angeles Times* described Galileo's flight, which was functioning perfectly toward Jupiter, apart from its malfunctioning antenna. Engineers sought both by heating and cooling the craft to unstick the antenna. The *New York Times* reported in detail on efforts by engineers at the Jet Propulsion Laboratory in Pasadena, operated by the California Institute of Technology for NASA, to free the antenna, thus salvaging the mission. If efforts failed, Galileo would be unable to communicate discoveries to scientists because the craft's small antennas could not transmit recorded pictures until returning to the vicinity of Earth. The third attempt to fix the antenna was pronounced a failure on August 20. Other possible courses of action were discussed. (*LA Times*, Aug 9/91; *NY Times*, Aug 12/91; *AP*, Aug 12/91; *W Times*, Aug 13/91; *W Post*, Aug 13/91; *USA Today*, Aug 13/91; *AP*, Aug 13/91; *AP*, Aug 20/91; *UPI*, Aug 20/91; *NY Times*, Aug 21/91; *P Inq*, Aug 21/91; *B Sun*, Aug 21/91; *UPI*, Aug 21/91; *AP*, Aug 28/91)

- The *Antelope Valley Press* quoted John Young, special assistant for engineering, operations, and safety at NASA's Johnson Space Center in Houston, as saying that for NASA to land Shuttles at Kennedy Space Center instead of Edwards Air Force Base in California posed an increased risk. Although the Florida landing saved NASA the cost of ferrying a Shuttle back from California and the five to seven days involved, Florida weather was more problematic. Furthermore, Edwards had more runway alternatives whereas Kennedy had only one. John E. Pike, space policy analyst for the Federation of American Scientists, said NASA should wait on Florida landings till all Shuttles were equipped with drag chutes to slow them down. (*Antelope Valley Press*, Aug 9/91)

August 10: *AP* reported that Space Shuttle Columbia was bolted atop a jumbo jet and flown from Cape Canaveral to MacDill Air Force Base in Tampa, before proceeding on August 11 to Rockwell International's Shuttle assembly plant in Palmdale, California. The arrival of Columbia in Palmdale on August 13 was greeted enthusiastically by the inhabitants. (*AP*, Aug 10/91; *Antelope Valley*, Aug 14/91)

August 12: The media gave extensive coverage to the smooth landing and successful mission of Atlantis that ended with touchdown at the Kennedy Space Center at Cape Canaveral on August 11. In addition to launching a giant communications satellite to channel data from low-orbiting spacecraft, the astronauts tested equipment, such as computer items, for possible Space Station use and conducted 22 scientific experiments. Several articles dealt with final experiments on board and preparations for landing. (*W Post*, Aug 10/91; *LA Times*, Aug 10/91; *AP*, Aug 10/91; *UPI*, Aug 10/91; *NY Times*, Aug 11/91; *W Post*, Aug 11/91; *NY Times*, Aug 12/91; *W Post*, Aug 12/91; *W Times*, Aug 12/91; *WSJ*, Aug 12/91; *P Inq*, Aug 12/91; *LA Times*, Aug 12/91; *AP*, Aug 12/91; *UPI*, Aug 12/91; *B Sun*, Aug 13/91; *NY Times*, Aug 13/91)

- A *Business Week* article on attempts to make the commercial space-launch business profitable, quoted NASA Deputy Administrator James R. Thompson Jr. He stressed the need for “real, nongovernmental customers” in order to make the program a success. The article summarized the work of various commercial firms and mentioned a number of instances of unsuccessful rocket launches. (*Bus Wk*, Aug 12/91)

- NASA announced that the first flight of a NASA ozone instrument on a Soviet spacecraft would occur in August. NASA’s Total Ozone Mapping Spectrometer (TOMS) was to be flown on a Soviet Meteor-3 meteorological satellite to be launched August 15 from the Plesetsk Cosmodrome aboard a Soviet Cylone rocket. (NASA Release 91-127; *LA Times*, Aug 16/91)

- The media discussed plans for NASA’s next Shuttle flight, that of Discovery in September, to deploy a satellite to study the ozone layer in Earth’s upper atmosphere. Discovery was moved to the launch pad, and various systems were connected to prepare for a practice countdown. (UPI, Aug 12/91; *W Times*, Aug 13/91; *USA Today*, Aug 13/91)

August 13: According to the wire services, two of three generators on Space Shuttle Atlantis were left running inadvertently after the landing. As a result, the generators were flooded with water, a byproduct of the power-generating process, and were being checked. (AP, Aug 13/91; UPI, Aug 14/91; *O Sen Star*, Aug 15/91; *Fla Today*, Aug 15/91)

- NASA announced the opening of the new Biocomputation Center at its Ames Research Center, Mountain View, California. The center, under Muriel Ross, had the task of studying the neural network to understand how nerves are organized and function. (NASA Release 91-129)

August 14: According to Patrick McCormick of NASA’s Langley Research Center in Hampton, Virginia, the eruption of Mount Pinatubo in the Philippines might cool global temperatures by a few tenths of a degree for as long as five to 10 years. (*W Post*, Aug 14/91)

- NASA announced that its Soft X-ray Telescope, which is designed to study solar flares, was scheduled to be launched aboard a Japanese spacecraft on August 26, under a cooperative agreement with the Japanese. (NASA Release 91-130)

- An article citing *Technology Review*, referred to the system developed by NASA’s Ames Research Center and Terra-Mar Resources Information Services to fight fires by enabling firefighters to “see” through the fire. (*San Francisco Examiner*, Aug 14/91)

August 15: The media reported the launch of the Soviet Meteor-3 weather satellite carrying the NASA-built Total Ozone Mapping Spectrometer (TOMS). The Meteor was to view the hole in the ozone over Antarctica in September and October; the United States and the Soviet Union were to share ozone information gained. (AP, Aug 15/91; UPI, Aug 15/91; *P Inq*, Aug 16/91; *W Post*, Aug 16/91; *LA Times*, Aug 16/91)

August 16: NASA announced that investigations of the sun's fiery outer atmosphere would intensify when the Ulysses spacecraft passed behind the sun on August 21. Edward J. Smith, Project Scientist for NASA's Jet Propulsion Laboratory, Pasadena, California, said that at conjunction (when the spacecraft and Earth are on opposite sides of the sun), radio waves transmitted from the spacecraft would travel through and become distorted by the innermost region of the corona. (NASA Release 91-131)

- NASA announced the granting of three study contracts to Lockheed Missiles and Space Company, Sunnyvale, California; McDonnell Douglas Corporation, Huntington Beach, California; and TRW, Redondo Beach, California. The contracts were intended to support the definition of the new National Launch System, a modular family of launch vehicles to support NASA and Department of Defense missions into the 21st century. (NASA Release C91-gg; UPI, Aug 16/91; Business Wire, Aug 19/91)

- An editorial commended NASA for considering a plan to decrease the risk of space experiments by using a larger number of small satellites, with smaller numbers of instruments. This would increase flexibility in the space program, making it more efficient and possibly cheaper. (*SF Chron*, Aug 16/91)

August 18: The *Washington Post* discussed the success of NASA engineers in fixing the computer software "bug" that caused spacecraft Magellan, after its arrival at Venus, to lose contact with Earth. Magellan Mission Director James Scott of NASA's Jet Propulsion Laboratory in California confirmed that the problem was solved and possible similar flaws in other space programs were being eliminated. (*W Post*, Aug 18/91)

- According to the *Los Angeles Times*, NASA researchers produced various vegetables in their imitation space garden, free from soil or sun, at Kennedy Space Center, Florida. The experiment, designed to prepare for Space Station existence, could not, however, reproduce weightlessness. (*LA Times*, Aug 18/91)

- Gregg Easterbrook, contributing editor for *Newsweek* and *Atlantic Monthly*, wrote a lengthy article criticizing NASA's slow response to the need for various reforms. He particularly faulted the formation of commissions as being easier than correcting errors and discussed the U.S.'s lack of a "throwaway space booster." (*W Post*, Aug 18/91)

August 20: The media covered the destruction after launch of Orbital Sciences Corporation's Aries rocket carrying secret Pentagon experiments for Star Wars. The rocket went out of control soon after liftoff and had to be destroyed. (AP, Aug 20/91; UPI, Aug 20/91; *NY Times*, Aug 21/91; *WSJ*, Aug 21/91; *W Post*, Aug 21/91; *USA Today*, Aug 21/91; *P Inq*, Aug 21/91; *W Times*, Aug 21/91; *B Sun*, Aug 21/91; *C Trib*, Aug 21/91; *LA Times*, Aug 21/91)

- NASA's Advanced Communications Technology Satellite (ACTS) Experiments Program Manager Dean Olmstead expressed NASA's pleasure that the U.S. Army had joined NASA to conduct various ACTS experiments. ACTS forms the center of NASA's satellite communications research and development efforts. (PR Newswire, Aug 20/91)

- NASA announced that researchers from its Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Virginia, would use satellite and airborne instruments to measure the surface elevation of polar glaciers. The program was designed to aid scientists in determining ice buildup or melting resulting from global climate change. The program is to occur in Greenland between August 23 and September 16. (NASA Release 91-133)

- NASA announced that its Joint Program Office, consisting of NASA and the Department of Defense, was sponsoring a competition for the Nation's undergraduate engineering schools to design and build a mock-up of the X-30 National Aerospace plane. (NASA Release 91-134)

- NASA announced that, subsequent to the failure of its attempt the preceding week to release the antenna of spacecraft Galileo, it would try again in December 1991 when Galileo would be farther from the sun and thus cooler. (NASA Release 91-135; AP, Aug 20/91; *LA Times*, Aug 21/91; UPI, Aug 21/91; *CSM*, Aug 22/91; *Htsvl Tms*, Aug 28/91)

August 21: AP reported that astronaut John Blaha, commander of the Atlantis mission, said he used the post-flight news conference to express his views on the space program and the importance of the Space Station, after reading criticism of the latter. (AP, Aug 21/91)

August 22: NASA announced that Space Shuttle Discovery, scheduled for launch on September 12, would deploy the Upper Atmosphere Research Satellite (UARS) 350 miles above Earth. The UARS is to study humankind's effect on the planet's atmosphere and its shielding ozone layer and is the first major flight element of NASA's Mission to Planet Earth. (NASA Release 91-136)

August 22: According to the *Washington Post*, the Hubble Space Telescope discovered evidence that dying stars can rejuvenate themselves when they col-

lide with each other. The violent collision enables them to be reborn as a younger, brighter star. (*W Post*, Aug 22/91; *NY Times*, Aug 27/91)

August 23: NASA announced crew members for eight future Space Shuttle missions, of which the first, a Microgravity Laboratory mission, is scheduled for May 1992. (NASA Release 91-137; AP, Aug 23/91; UPI, Aug 23/91; *LA Times*, Aug 24/91; *AvWk*, Aug 26/91)

- NASA Administrator Richard H. Truly announced the selection of General Spence M. Armstrong, USAF (Retired), for the newly established position of Associate Administrator for Human Resources and Education. (NASA Release 91-138)
- Concurrently, NASA Administrator Richard H. Truly announced the appointment of Michael D. Griffin for the new position of Associate Administrator for Exploration. (NASA Release 91-139; *SP News*, Aug 26-Sep 8/91)
- NASA program scientist Edward Weiler said in a telephone interview with UPI that an emergency Shuttle mission to replace faulty gyroscopes and solar panels aboard the Hubble Space Telescope was not needed before a flight already set for 1993 or early 1994. As a precaution, however, NASA engineers were perfecting computer control software that would stabilize the telescope if all its gyroscopes were to fail, until a Shuttle repair mission were mounted. (UPI, Aug 23/91)

August 26: The media carried the discovery, announced on August 23, by three astronomers, Donald P. Schneider of the Institute for Advanced Study in Princeton, Maarten Schmidt of the California Institute of Technology, and James E. Gunn of Princeton University of the oldest and most distant object yet found, a 900-million-year-old quasar. The discovery resulted from the use of a supersensitive digital camera, developed by Gunn for the Hubble Telescope. The camera was attached to Mount Palomar's Hale telescope and special filters were used. (*B Sun*, Aug 26/91; *NY Times*, Aug 27/91; *W Times*, Aug 27/91; *LA Times*, Aug 27/91)

- An editorial in a space publication urged the Bush Administration to put pressure on NASA to implement the recommendations of the Augustine panel with regard to NASA's structure, management, and priorities, and the Synthesis Group, or Stafford report on exploration missions. (*SP News*, Aug 26-Sep 8/91)
- *Space Propulsion* newsletter carried a discussion of NASA's 1993 budget plan, scheduled to be submitted to the White House August 30. In view of budget limitations, and an inflation rate of 4.1 percent, the article highlighted the call in the Senate report for NASA to submit a budget that assumed only a five percent annual increase through 1995. (*SP News*, Aug 26-Sep 8/91)

August 27: Michael Griffin, deputy for technology at the Pentagon's Strategic Defense Initiative Organization, said that the reason the Aries rocket of Orbital Sciences Corporation had to be destroyed when it went off course on August 20 was that a technician loaded the wrong computer program into the rocket's guidance unit. The matter would be investigated. (*P Inq*, Aug 27/91; *W Times*, Aug 27/91; *W Post*, Aug 27/91; *NY Times*, Aug 27/91; *USA Today*, Aug 27/91; *LA Times*, Aug 27/91; AP, Aug 27/91)

- NASA's Lewis Research Center, Cleveland, the American Institute of Aeronautics and Astronautics, and the Ohio Aerospace Institute announced the cosponsorship of a conference on Advanced Space Exploration Initiative (SEI) Technologies at the Cleveland Convention Center September 4-6. The conference is to be part of the Lewis Center's 50th anniversary celebration. (NASA Release 91-140)

- The *Wall Street Journal* featured two inventors, of whom one, Khanh Dinh of Vietnamese origin, with NASA's assistance, developed an innovative heat pipe technology. His company won a NASA contract to work on the heat-removal system for the Space Shuttle and also won a federal award for helping to commercialize space technology. (*WSJ*, Aug 27/91)

August 28: NASA announced the selection of BDM Federal, Inc., McLean, Virginia, as the mission advisory and assistance contractor for the Earth Observing System Program Office in Washington. (NASA Release C91-ii)

- NASA announced that September 12 was set for the launch of Space Shuttle Discovery and its Upper Atmosphere Research Satellite. The announcement followed completion of the Flight Readiness Review. (NASA Launch Advisory, Aug 28/91; CSM, Aug 28/91; UPI, Aug 28/91; DPA, Aug 28/91; *P Inq*, Aug 29/91; *W Times*, Aug 29/91; *NY Times*, Aug 29/91; *USA Today*, Aug 29/91; *LA Times*, Aug 29/91; AP, Aug 29/91)

- Bob MacMillan, public information manager for the Jet Propulsion Laboratory in Pasadena, said scientists had ordered the Magellan spacecraft to reduce its mapping of Venus and stay in the shade to prevent recording equipment from overheating. (AP, Aug 28/91)

- James R. Thompson, NASA Deputy Administrator, was quoted as praising NASA's preeminence in space and aeronautics technology but admitting its recent difficulties. In view of these, Thompson indicated he thought NASA should slow its push for the Space Station and instead adapt the Space Shuttle to fly longer missions to demonstrate why a Space Station would be valuable. (*Birmingham News*, Aug 29/91)

August 30: NASA announced that the Magellan spacecraft, mapping the surface of Venus with imaging radar, had discovered the longest channel known in the solar system, 4,200 miles long. Steve Saunders, Project Scientist at NASA's Jet Propulsion Laboratory, Pasadena, said it was not known what formed the channel. (NASA Release 91-141; *LA Times*, Aug 30/91; UPI, Aug 30/91)

- Japan's Institute of Space and Astronautical Science announced that Japan had successfully launched a solar flare observation satellite, designed to analyze X-rays and gamma rays from solar flares. (DPA, Aug 30/91)

- *Exploring the Moon and Mars*, a report by the congressional Office of Technology Assessment, was quoted. The report advocated the need for the United States to take the development and use of robotic technology more seriously if robots are to be used in a mission to Mars. Furthermore, the report projected that robots would be considerably cheaper than human exploration that NASA appeared to favor. (*W Times*, Aug 30/91)

- Robert C. Cowen, a science writer for the *Christian Science Monitor*, wrote of a recent article in the journal *Science* by Compton J. Tucker and Wilbur W. Newcomb of NASA's Goddard Space Flight Center in Greenbelt, and Harold E. Dregne of Texas Technical University in Lubbock. They used American polar-orbiting weather satellites to show the shifting sands of the Sahara Desert. (*B Sun*, Aug 30/91)

- AP reported that the Baikonur Space Station in western Kazakhstan seemed ready to avoid the problems that harmed nuclear testing at Semipalatinsk. A Soviet space delegation visited the Kazakh capital of Alma Ata in April to conclude a program of scientific, technical, and economic cooperation between the two countries and to build a training school for young cosmonauts in Leninsk. (AP, Aug 30/91)

- According to the Press Trust of India, quoting the Indian Space Research Organization, India's second remote-sensing satellite, launched on August 29 by a Soviet rocket from the Baikonur cosmodrome, sent back its first pictures August 30. (AP, Aug 30/91)

August 31: The media covered NASA comments on new discoveries about Venus, which appeared to have ongoing geological processes. Jeffrey J. Plaut, a NASA scientist, compared radar images taken by the Magellan spacecraft in November 1990 with those taken in July 1991. The images revealed what Stephen Saunders, the Magellan Project scientist, described as a "giant landslide." (*P Inq*, Aug 31/91; *W Post*, Aug 31/91; *NY Times*, Aug 31/91; *LA Times*, Aug 31/91; AP, Aug 31/91; UPI, Aug 31/91)

September

September: Mark Washburn, a freelance science writer who covered NASA for 15 years, questioned whether NASA was needed, having become a huge, entrenched bureaucracy. He advocated the following: giving aeronautical functions to the Federal Aviation Administration; giving the Space Shuttle to the Pentagon; turning over weather satellites and other Earth-resource payloads to the National Center for Atmospheric Research and the National Oceanic and Atmospheric Administration; putting planetary and astronomical missions under the National Science Foundation; granting independence to NASA centers such as the Jet Propulsion Laboratory, Ames Research Center, and Goddard Space Center; and replacing headquarters with a National Space Policy Commission, similar to the Federal Communications Commission. Washburn believed such measures were necessary to preserve America's future in space. (*Sky and Telescope*, Sep 1991)

- In an article entitled "Freedom's Wobbly Flight," Mark L. Goldstein criticized NASA's large spending on the Space Station at the expense of other NASA programs. He gave a history of the Freedom program, its costs, and its relationship to Congress as well as the criticisms by the scientific community. (*Government Executive*, Sep 1991)

- Steve Piacente, Washington correspondent for the *Charleston Post-Courier*, wrote "Weather Service Modernization: No Goes" describing problems of the National Oceanic and Atmospheric Administration (NOAA) and NASA with launching new weather satellites. Lack of effective supervision of contractors and poor engineering workmanship were among the shortcomings. (*Government Executive*, Sep 1991)

- Henry S.F. Cooper, Jr., in an 18-page article in the *New Yorker* entitled "Annals of Space—We Don't Have to Prove Ourselves," discussed NASA's programs primarily as seen from the work of two prominent NASA veterans, Maxime A. Faget, chairman of the board of Space Industries International, and Caldwell C. Johnson, the firm's chief designer. (*New Yorker*, Sep 1991)

September 1: Galileo Galilei, the 17th century Italian astronomer, is to be the first classical scientist to be honored by the Space Hall of Fame in Alamogordo, New Mexico. The U.S. spacecraft on its way to Jupiter since 1989 was named in his honor. (*C Trin*, Sep 1/91)

- The *Los Angeles Times* reported that in order to minimize the impact on California's economy of job losses in the aerospace industry, Governor Pete Wilson sent letters to Congress supporting the B-2 bomber and NASA's Space Station project. (*LA Times*, Sep 1/91)

September 2: The media reported the Air Force announcement that the second attempted launch of an Aries rocket carrying Star Wars experiments was postponed for at least one month because of a technical problem. (AP, Sep 2/91; *NY Times*, Sep 3/91; *W Post*, Sep 3/91; *W Times*, Sep 3/91; *P Inq*, Sep 3/91; *USA Today*, Sep 3/91; *C Trin*, Sep 3/91; *LA Times*, Sep 3/91)

- The *Los Angeles Times* covered the fifth annual Conference on Small Satellites, held at Utah State University. Most of the scientists and engineers attending favored NASA using smaller satellites for specific goals rather than larger spacecraft, which they believed to be NASA's trend. (*LA Times*, Sep 2/91)

September 3: The *New York Times* reported that Soviet space officials told the White House that the Soviet civilian space program might collapse unless it made large sales to the West. Soviet economic problems were the major cause as well as parliamentary attacks on the space program as wasteful. (*NY Times*, Sep 3/91; UPI, Sep 3/91; *USA Today*, Sep 4/91; *Fla Today*, Sep 4/91)

- A *Chicago Tribune* article discussed the progress and problems facing the development of the National Aerospace Plane. One of the difficulties was that above Mach 8, engineers deal with such high speeds that there are no wind tunnels in which simulations can be performed. Furthermore, six separate designs from five major contractors: Rockwell International, General Dynamics, McDonnell Douglas, Pratt and Whitney, and the Rocketdyne Division of Rockwell International were integrated into a single vehicle. More than 1,000 engineers from these firms were assigned to the project. (*C Trin*, Sep 3/91)

September 4: The *Baltimore Sun* reported that NASA engineers were trying to fix an intermittent power failure in the Hubble Space Telescope affecting one of the two ultraviolet detectors housed in the Goddard High Resolution Spectrograph. As a result, some 30 percent of research planned for the spectrograph must be postponed. (*B Sun*, Sep 4/91; *LA Times*, Sep 9/91)

- According to UPI, an Atlas-2 rocket built by General Dynamics Corporation was seriously damaged during a fueling test at the launch pad on August 25. As a result, the rocket's launch, which was to ferry a Defense Satellite Communications System satellite into orbit for the Pentagon, was postponed till November. (UPI, Sep 4/91)

- *Florida Today* described the opening on September 3 at the Kennedy Space Center of a third garage for NASA's Orbiter Space Shuttle fleet. The hangar was outfitted with equipment intended for the Air Force's mothballed Shuttle launch site at Vandenberg Air Force Base in California, saving NASA about \$40 million. (*Fla Today*, Sep 4/91)

September 5: AP covered the three-day conference attended by more than 500 people, in Cleveland, home of NASA's Lewis Research Center, to discuss advanced Space Exploration Initiative technology. A number of NASA officials participated and cited the need to get the support of the American public to send people back to the Moon and on to Mars. Nuclear rocket technology and space mechanics were among topics covered. (AP, Sep 5/91; *Cleveland Plain Dealer*, Sep 5/91)

September 6: NASA announced that scientists at the Ames Research Center, Mountain View, California, and the Paris Observatory, using data from the Voyager 1 spacecraft, for the first time had described an anti-greenhouse effect on a solar system body. In an article in *Science* magazine, they also described the temperature structure and energy balance on Titan, Saturn's largest moon. (NASA Release 91-143)

September 7: Extensive media coverage preceded the scheduled launching of Space Shuttle Discovery on September 12. The countdown was planned to begin on September 9, but the discovery of a leak in the orbital steering system might delay the mission. The flight was to be the first in NASA's Mission to Planet Earth program and was to place into orbit the Upper Atmosphere Research Satellite (UARS). The UARS was to carry 10 scientific instruments, of which four would study the ozone layer. (AP, Sep 7/91; AP, Sep 8/91; *W Post*, Sep 8/91; *NY Times*, Sep 8/91; *P Inq*, Sep 9/91; *W Post*, Sep 9/91; *W Times*, Sep 9/91; *USA Today*, Sep 9/91; *C Trin*, Sep 9/91; *B Sun*, Sep 10/91; *NY Times*, Sep 10/91; *P Inq*, Sep 10/91; *W Times*, Sep 10/91; *LA Times*, Sep 10/91; AP, Sep 10/91; UPI, Sep 10/91)

- The media reported the concern of Soviet cosmonauts aboard the Mir Space Station that the station and the space program in general might be sold because of Russia's economic plight. The role of the new Soviet republics with regard to space was also undetermined. Subsequently, Yuri Semenov, general designer of the Energia team that managed Mir, said according to Tass, that the Space Station would remain the property of his collective. (*NY Times*, Sep 7/91; AP, Sep 7/91; *P Inq*, Sep 8/91; *B Sun*, Sep 8/91; AP, Sep 12/91; *NY Times*, Sep 13/91)

- UPI quoted the publication *Aviation Week and Space Technology* as saying that a huge Soviet SL-16 Zenit rocket carrying a spy satellite exploded shortly after launch on August 30. (UPI, Sep 7/91)

- A local newspaper described the flight of the ER-2 (Earth Resources) giant high-flying spy plane that flew over the San Joaquin-Sacramento Valley. In 4 1/2 hours, the plane of the NASA-Ames Research Center captured more than seven million acres on film. The photographs were to be a resource for the best use of water supplies in California. (*Bakersfield Californian*, Sep 7/91)

September 9: According to the *New York Times*, the National Oceanic and Atmospheric Administration was completing arrangements to get exclusive use of the European weather satellite Meteosat-3. The purpose would be to move it further west to cover the United States more thoroughly if the U.S. weather satellite, GOES-7, were to fail. NASA was several years behind in the development of new U.S. weather satellites, the GOES-NEXT, originally scheduled to begin operating in 1989 but now probably late 1992 at the earliest. Subsequently, several newspapers reported arrangements made for the United States to borrow at least one and possibly more European weather satellites. (*NY Times*, Sep 9/91; *W Post*, Sep 14/91; *NY Times*, Sep 15/91; *B Sun*, Sep 15/91)

- In a detailed presentation accompanied by a statistical table, the *Wall Street Journal* recounted the planned and actual flight dates and costs of NASA space projects to date. It concluded that the UARS flight of Discovery was the only one to stay within its cost projection, but it would be almost two years late. (*WSJ*, Sep 9/91)

- A space publication printed an adapted version of Senator Dale Bumpers' (Democrat from Arkansas) speech when he introduced legislation in July to cut funding on the NASA Space Station drastically. He favored solving U.S. problems on the ground, not in space. The same issue carried remarks of Senator Jim Sasser (Democrat from Tennessee) that the Space Station was something the United States could not afford. Furthermore, the magazine carried an interview with Jim Beggs, chairman of Spacehab Inc. and former NASA Administrator, concerning his organization's relationship to NASA. (*SP News*, Sep 9-15/91)

September 10: Lennard A. Fisk, NASA's Associate Administrator for Space Science and Applications, announced the appointment of Dirk D. Frimout as payload specialist for the Atmospheric Laboratory for Applications and Science (ATLAS-1) Spacelab mission, scheduled for early 1992. (NASA Release 91-144)

September 11: Lennard Fisk, NASA's Associate Administrator, announced that the two largest mirrors for NASA's Advanced X-ray Astrophysics Facility have been tested successfully in the new X-ray Calibration Facility at Marshall Space Flight Center, Huntsville, Alabama. (NASA Release 91-145)

- NASA also announced that President George Bush would join NASA Administrator Richard Truly in a back-to-school special program for elementary students on NASA Select Television. (NASA Release 91-146)

September 12: The media covered extensively final preparations leading up to the evening launch of Discovery in its 13th flight, a record. Biographic data

were given concerning members of the mission as well as descriptions of the satellite to be launched to gather ozone information. (*B Sun*, Sep 12/91; *NY Times*, Sep 12/91; *USA Today*, Sep 12/91; *P Inq*, Sep 12/91; *LA Times*, Sep 12/91; *AP*, Sep 12/91; *UPI*, Sep 12/91; *NY Times*, Sep 13/91; *B Sun*, Sep 13/91; *P Inq*, Sep 13/91; *W Post*, Sep 13/91; *WSJ*, Sep 13/91; *USA Today*, Sep 13/91; *W Times*, Sep 13/91; *LA Times*, Sep 13/91; *AP*, Sep 13/91; *UPI*, Sep 13/91; *LA Times*, Sep 14/91; *NY Times*, Sep 14/91)

- NASA announced the launching by *USA Today*, together with NASA and the National Association of Elementary School Principals, of "Visions of Exploration." This was the first multimedia educational program designed to bring the spirit of exploration into the classroom in 1992, the International Space Year. (NASA Release 91-147)

September 13: NASA Administrator Richard H. Truly announced plans to create a new Office of Space Flight Development. This would allow the existing Office of Space Flight to concentrate on the safety and efficiency of space flight. (NASA Release 91-148)

- According to the *Los Angeles Times*, an ingenious "Mars rover" that Soviet scientists want to send to Mars, was ready to be tested in the Mojave Desert. The desert was selected because it resembles the surface of Mars. (*LA Times*, Sep 13/91)

- The local newspaper carried an article on an area resident, Dale Reed, who said his "lifting-body concept"—an aircraft shape that eliminated the need for wings, influenced the design of the Space Shuttle. He built scale models of his idea and convinced his boss, Paul Bikle, Director of NASA's Dryden Flight Research Center at Edwards Air Force Base, to try it on a glider. Reed was a NASA engineer for 32 years and subsequently worked as senior engineer for PRC, Inc., a NASA contractor. (*Antelope Valley Daily News*, Sep 13/91)

September 14: Several newspapers commented on the study by a panel of experts, headed by Edward A. Frieman of Scripps Institution of Oceanography, released by the Federation of American Scientists. The report recommended that NASA scrap plans for six huge scientific platforms to gather data for studies of global warming as part of the Earth Observation System. Instead, experts urged that NASA use smaller satellites that could provide critical data more quickly and more cheaply. (*LA Times*, Sep 14/91; *NY Times*, Sep 16/91; *Time*, Sep 16/91; *NY Times*, Sep 20/91)

September 15: NASA's launch of the UARS satellite to study the ozone layer was covered extensively by the media. The launch was slightly delayed by communications hitches between ground and the satellite and communications difficulties continued after the launch. Later reports, however, indicated

controllers had succeeded in getting the faulty data receiver to work. On September 16, the Discovery temporarily had to move to a lower orbit to avoid possible collision with an old Soviet rocket. (*NY Times*, Sep 15/91; *B Sun*, Sep 15/91; *P Inq*, Sep 15/91; *W Post*, Sep 15/91; AP, Sep 15/91; UPI, Sep 15/91; *NY Times*, Sep 16/91; *B Sun*, Sep 16/91; *USA Today*, Sep 16/91; *W Post*, Sep 16/91; *W Times*, Sep 16/91; *B Sun*, Sep 17/91; *W Times*, Sep 17/91; *P Inq*, Sep 17/91)

September 16: NASA Administrator Richard H. Truly released a letter from Norman R. Augustine, former chairman of the Advisory Committee on the Future of the U.S. Space Program, assessing NASA's efforts over the preceding nine months to implement the committee's recommendations. The letter recognized that NASA took "many significant actions" but "much is yet to be accomplished." (NASA Editors' Note N91-60; UPI, Sep 16/91)

- According to *Aviation Week and Space Technology*, quoting the Earth Observing System (EOS) Engineering Review Panel, NASA's plans for EOS satellites A and B "should be completely reconfigured." The panel also stated that the EOS Data and Information System was incorrectly configured and lacked central control of data archiving and distribution. NASA released the report on September 23. The same issue of the magazine reported that NASA was discussing with Martin Marietta reintroducing the Titan 3 booster to launch the EOS spacecraft into polar orbit from Vandenberg Air Force Base, California, in the late 1990s. (*AvWk*, Sep 16/91; NASA Editor's Note N91-64)

September 17: The media covered preparations of the Discovery crew for the first Shuttle night landing at Cape Canaveral, scheduled for September 18. As it developed, the bad weather forced a diversion of the Shuttle from Florida, and the actual landing occurred the night of September 18 at Edwards Air Force Base, California. Reportedly, preliminary findings were that the Shuttle was in good shape after its landing. (*USA Today*, Sep 17/91; AP, Sep 17/91; UPI, Sep 17/91; *W Times*, Sep 18/91; *USA Today*, Sep 18/91; *W Post*, Sep 18/91; *C Trin*, Sep 18/91; AP, Sep 18/91; UPI, Sep 18/91; *P Inq*, Sep 19/91; *NY Times*, Sep 19/91; *W Times*, Sep 19/91; *WSJ*, Sep 19/91; *W Post*, Sep 19/91; *USA Today*, Sep 19/91; *LA Times*, Sep 19/91; AP, Sep 19/91; *B Sun*, Sep 19/91)

- AP reported, as quoted in the *Washington Times*, that the Soviet cosmonauts were waiting to return home, puzzled by home conditions. Their return was postponed after the Republic of Kazakhstan claimed ownership of the territory on which they were supposed to land. Furthermore, the Soviet space program was experiencing financial and administrative difficulties. (AP, Sep 17/91; *W Times*, Sep 17/91)

- NASA announced the resignation for personal reasons of Deputy Administrator J.R. Thompson Jr., an internationally recognized propulsion expert, who served more than 25 years in NASA. (NASA Release 91-149;

AP, Sep 17/91; *W Post*, Sep 18/91; *Decatur Daily*, Sep 18/91; *Htsvl Tms*, Sep 18/91; *Birmingham News*, Sep 18/91; *NY Times*, Sep 19/91; *Birmingham Post-Herald*, Sep 19/91; *AvWk*, Sep 23/91)

- President George Bush, speaking to school children over a NASA hook-up, said he would probably be rejected by NASA for a space launch because of his age, 67. (UPI, Sep 17/91; AP, Sep 17/91; *W Times*, Sep 18/91)

September 18: According to AP, NASA and the Pentagon were undecided how much information they would give about the next Shuttle mission, the November launch of Atlantis, intended to release a satellite designed to spot an enemy missile attack. (AP, Sep 18/91)

September 19: A senior U.S. trade official, on condition of anonymity, stated that Japan had drafted a plan to subsidize the entry of several Japanese companies into the commercial satellite-building industry but abandoned the plan under U.S. pressure. Hiroshi Hirabayashi, economics minister at the Japanese Embassy in Washington, confirmed the existence of such a plan but said if implemented it would probably be limited to research satellites. (*NY Times*, Sep 19/91; *WSJ*, Sep 19/91)

- NASA issued a preliminary report on findings of the June Spacelab Shuttle mission. The human body's adaptation to weightlessness began on the launch pad and researchers needed to develop new ways to counteract these physiological effects. These effects include weight loss, loss of body fluid, drop in red blood cell production, and reduced heart pumping capacity. (UPI, Sep 19/91; AP, Sep 20/91; *NY Times*, Sep 20/91; *W Post*, Sep 20/91; *USA Today*, Sep 20/91)

September 23: NASA announced that its Goddard Space Flight Center/Wallops Flight Facility, Wallops Island, Virginia, had selected H and H Consolidated, Inc. of Hampton, Virginia, for an operation/maintenance and alteration contract of facilities and equipment services. (NASA Release C91-jj)

- *Business Week* reported that NASA planned to use three giant, 70-foot-tall computer-controlled robots to inspect, clean, dry, and line new and refurbished solid rockets for space flights. Vadeko International, Inc., a Canadian engineering company, was to design and build the robotic system, to be in service in 1993. (*Bus Wk*, Sep 23/91)

- NASA announced the renaming of the Gamma Ray Observatory, deployed April 7, 1991, by Space Shuttle Atlantis, in honor of American physicist Arthur Holly Compton. (NASA Release 91-151)

- Gerald Fishman of NASA's Marshall Space Flight Center at a press conference spoke of the findings of the Gamma Ray Observatory to date. He said

that an instrument called the Burst and Transient Source Experiment had detected 117 gamma ray bursts since launching. These bursts were randomly scattered, not from the center of the Milky Way Galaxy as previously thought. (AP, Sep 23/91; *P Inq*, Sep 24/91; *USA Today*, Sep 24/91; *W Post*, Sep 24/91; *NY Times*, Sep 24/91; *W Times*, Sep 24/91)

- The Government Accounting Office issued a study criticizing NASA's system of testing spacecraft before launching. It called the system poorly organized with testing practices varying from one center to another because NASA lacked uniform policies. The study dealt with the Hubble Space Telescope and the weather satellites, as well as Space Shuttles. (AP, Sep 23/91; UPI, Sep 23/91; *LA Times*, Sep 23/91; *NY Times*, Sep 24/91; *USA Today*, Sep 24/91; *WSJ*, Sep 24/91; *W Times*, Sep 24/91)

- The *Chicago Tribune* featured Elmhurst College professor Frank Mittermeyer who has been growing tomatoes from some 1,000 seeds that orbited Earth for six years and were retrieved by Space Shuttle Challenger in 1990. Mittermeyer noticed the second generation of space tomatoes were not as robust as the first. (*C Trin*, Sep 23/91)

- NASA announced that the first United States-Soviet space art team exchange would occur on September 28 when the U.S. team arrived in Moscow. The purpose was to have each team produce paintings of the other country's space activities. (NASA Release 91-152)

- NASA announced that scientists and engineers at its Jet Propulsion Laboratory, Pasadena, California, successfully tested the mini-rover Rocky III in the Avawatz Mountains south of Death Valley. The mini-rover, weighing 52 pounds, was designed to be used on Mars. (NASA Release 91-153; *Bus Wk*, Sep 9/91)

September 24: According to the *Washington Times*, Aurora Flight Services Corporation of Manassas, Virginia, won a contract from NASA for up to three of Aurora's Perseus A pilotless high altitude research aircraft. (*W Times*, Sep 24/91)

September 25: The media covered NASA spokesman Mitch Varnes' report that during routine structural inspections of Atlantis in the hangar cracks were discovered on the protective panel joints of the wings. As a result, NASA was stripping the special, heat-resistant seals and seeking to discover the source of the cracks. It was uncertain whether the discovery would delay the November launch of Atlantis. (UPI, Sep 25/91; AP, Sep 26/91; UPI, Sep 26/91; *NY Times*, Sep 27/91; *W Times*, Sep 27/91; *W Post*, Sep 27/91; *USA Today*, Sep 27/91)

- The press reported that Space Shuttle Discovery left California on September 24 enroute back to Florida, flying piggyback aboard a jetliner. (*LA Times*, Sep 25/91; UPI, Sep 26/91; *NY Times*, Sep 27/91)

September 26: NASA announced that Franco Malerba would be Prime Payload Specialist and Umberto Guidoni Backup Payload Specialist for the Tethered Satellite System mission on Space Shuttle Atlantis in the summer of 1992. This is a cooperative mission between NASA and Italy's space agency, Agenzia Spaziale Italiana. (NASA Release 91-154)

- NASA announced that preliminary data from its Upper Atmosphere Research Satellite appeared to confirm aircraft and ground-based research about the chemical processes leading to ozone depletion. (NASA Release 91-155)

- AP reported that House-Senate legislators agreed to provide \$26 billion in 1992 for NASA's planned Space Station. (AP, Sep 26/91; *Htsvl Tms*, Sep 28/91; *Htsvl Tms*, Sep 29/91)

- NASA announced that scientists studying data from spacecraft Galileo concluded there were lightning storms on Venus. *Science* magazine just published eight scientific articles based on Galileo's Venus observations. (NASA Release 91-156; *W Post*, Sep 30/91)

September 27: NASA Administrator Richard H. Truly presented the Minority Contractor of the Year Award to Consolidated Industries, Inc., of Huntsville, Alabama, and the Minority Subcontractor of the Year Award to Network Solutions, Inc., of Herndon, Virginia. (NASA Release 91-157)

- In response to the House-Senate Conference report on the FY 1992 budget, NASA Administrator Richard H. Truly said that NASA was very grateful for the funding for Space Station Freedom. However, it was disappointed that the total NASA appropriation did not keep up with inflation. (NASA Release 91-158)

- The Discovery astronauts held a press conference at which they answered questions about their flight. They indicated it was easy to avoid the Soviet rocket chunk but that space debris could be a major threat to future crews. The amount of haze in the atmosphere from Mount Pinatubo or other sources, particularly struck astronauts who participated in earlier flights and aroused concern for the environment. (AP, Sept 27/91; UPI, Sep 27/91; *LA Times*, Sep 28/91)

- The *Huntsville Times* reported that engineers at Marshall Space Flight Center had successfully tested a 17.5-foot-long solid rocket motor on September 26. (*Htsvl Tms*, Sep 27/91)

- According to the *Huntsville Times*, Boeing donated \$300,000 on September 26 toward building a full-size mockup of Space Station Freedom at the U.S. Space and Rocket Center in Huntsville. (*Htsvl Tms*, Sep 27/91)

September 28: The *Philadelphia Inquirer* reported that the six moons of Neptune discovered by *Voyager 2* spacecraft in 1989 were given names by the International Astronomical Union's Central Bureau for Astronomical Telegrams. In addition, Saturn's newest moon, Pan, was discovered by Mark Showalter, a scientist at NASA's Ames Research Center in Mountain View, California. (*P Inq*, Sep 28/91)

September 29: The *Washington Times* discussed the viability of the Washington area as a launch/landing site for space rockets. The various space-related industries already found in the area were mentioned, but an engineering school was lacking to provide a local talent pool. (*W Times*, Sep 29/91)

- The *Washington Times* also dealt with space law and the risks involved in such matters as rocket launches. In the latter connection, it cited Orbital Sciences Corporation and its difficulties. Because most commercial space companies had NASA or the U.S. government as a customer, changes in government had an impact on the legal aspects. (*W Times*, Sep 29/91)

- According to the *Washington Post*, in an article on the use of chlorofluorocarbons (CFCs) and their impact on the environment, NASA used 20,000 gallons of CFCs yearly to decontaminate the inside of its Space Shuttles and orbiters and to scrub down the hardware on the launch pads. (*W Post*, Sep 29/91)

- The *Washington Times* asserted that science fiction based on the work of Isaac Asimov influenced Bib Citron who helped design the Spacehab module through his work for the Space Travel Company. The flight of the first Spacehab module was to be in July 1993. (*W Times*, Sep 29/91)

September 30: According to the *Washington Post*, new findings of astronomers tended to indicate that the universe was both smaller and younger than previously thought. The result, if the Hubble Space Telescope should be able to provide accurate readings on the matter, might prove that the calculations of the Hubble constant (regarding the age and size of the universe) needed to be revised. (*W Post*, Sep 30/91)

- NASA announced that the Soft X-ray Telescope, one of four instruments on the Japanese Solar-A spacecraft launched August 30, 1991, took its first soft x-ray image of the sun. (NASA Editor's Note N91-68)

October

October 1: In an editorial entitled "Fiscal Realism at NASA," NASA was commended for its reported readiness to stress smaller, less costly missions. In this connection, the paper believed that Space Station Freedom should be scrapped as well as the Earth Observing System platforms. (CSM, Oct 1/91)

- The *New York Times* cited the recent issue of *Nature* with articles by NASA scientists and others on the possibility of using advanced technologies to make Mars's environment more terrestrial and thus hospitable to humans. A May issue of *Life* magazine was also cited as evidence of growing scientific interest in the potential habitability of Mars. Nevertheless, serious obstacles remained, in addition to the tremendous costs that would be involved. (NYT, Oct 1/91)

October 2: The media covered extensively NASA's receiving \$2 billion for the planned Space Station in the House budget action but having a new launch system and the National Aerospace Plane cut drastically. The House voted to give NASA 14.3 billion in FY 1992 and the Senate later approved the compromise bill. (UPI, Oct 2/91; AP, Oct 3/91; *P Inq*, Oct 3/91; *C Trin*, Oct 3/91; *NY Times*, Oct 3/91; *W Times*, Oct 3/91; *LA Times*, Oct 3/91; *USA Today*, Oct 3/91; CSM, Oct 4/91)

- NASA said small cracks were found in the thermal seals on the wings of a second Space Shuttle, the Columbia. The cause of the cracks remained undetermined. (AP, Oct 2/91; *Fla Today*, Oct 2/91; *W Times*, Oct 3/91)

- A Soyuz rocket blasted off from the Baikonur Cosmodrome for the Mir Space Station carrying an Austrian electronic engineer and the first cosmonaut from the Republic of Kazakhstan, where Baikonur is located. The joint Soviet-Austrian mission was part of a Soviet effort to help pay for the space program with joint international flights. Tass reported the rocket docked with Mir on October 4. On October 10, two Soviet cosmonauts and the first Austrian in space returned to Earth, according to Tass. (AP, Oct 2/91; UPI, Oct 2/91; *P Inq*, Oct 3/91; *C Trin*, Oct 3/91; AP, Oct 4/91; AP, Oct 10/91)

October 3: NASA's Soft x-ray Telescope aboard the Japanese Solar-A spacecraft launched from Japan's Kagoshima Space Center on August 30, made its first x-ray images of the sun. The purpose of the mission was to produce pictures of the genesis and life of solar flares to enable scientists to learn more about them. (*W Times*, Oct 3/91)

- NASA announced that the X-29, an unusual research aircraft built to investigate the feasibility of a forward-swept wing design, made its last flight in its

high angle of attack research program on September 30 at NASA's Ames-Dryden Flight Research Facility, Edwards, California. (NASA Release 91-159; *Antelope Valley Press*, Oct 4/91)

- NASA Administrator Richard H. Truly announced the planned creation of the Office of Management Systems and Facilities. Benita A. Cooper was to be the Associate Administrator for this office which was to enhance total quality management. (NASA Release 91-160)

- NASA Administrator Richard H. Truly announced two key appointments: Arnold D. Aldrich to be Associate Administrator for the new Office of Space Systems Development and Richard H. Petersen to become Associate Administrator for the Office of Aeronautics and Space Technology. (NASA Release 91-161; AP, Oct 3/91; *Daily Press*, Oct 4/91; *W Post*, Oct 10/91)

- NASA discovered cracks in the protective thermal layer of the wings of Discovery, the third Space Shuttle to experience this problem. (AP, Oct 3/91; *W Times*, Oct 4/91)

October 4: NASA announced the selection of two new institutions to serve as NASA Specialized Centers of Research and Training (NSCORT). The centers are to be at the University of California, San Diego, and Lawrence Berkeley Laboratory, Berkeley, California. A foreign center, the University of Giessen, was tentatively selected but awaited full endorsement and funding by the German government. (NASA Release 91-163)

- NASA announced the selection of MK-Ferguson Corporation, Cleveland for a contract to provide engineering, construction, and maintenance services to NASA's Lewis Research Center, Cleveland. (NASA Release C91-mm)

October 5: William B. Lenoir said NASA's manned space flight division must cut expenses by three percent each year in the next five years to save \$1 billion. The last alternative would be to reduce the number of space flights but that would be "a couple of years away." Later media comments indicated that NASA's budgetary discipline and the slimming down of the Space Station plans appeared to be paying off for NASA in relation to Congress. (AP, Oct 5/91; *AvWk*, Oct 21/91; *W Post*, Oct 28/91)

- The *Baltimore Sun* published an article quoting Richard Stolarski, research scientist at NASA's Goddard Space Flight Center, concerning ozone depletion. He stated that the hole in the ozone layer over the Antarctic failed to shrink as was hoped. He wondered whether the same might occur over the North Pole and indicated the need to understand the limits under which ozone depletion occurred. Subsequently, NASA announced the findings of its Total Ozone Mapping Spectrometer, which indicated the ozone depletion in

Antarctica was almost as severe as the record year of 1987. (*B Sun*, Oct 5/91; NASA Release 91-165; AP, Oct 9/91; UPI, Oct 9/91; *NY Times*, Oct 10/91; *USA Today*, Oct 10/91; CSM, Oct 10/91; *W Post*, Oct 11/91)

October 7: An editorial in a space publication criticized NASA and the National Oceanic and Atmospheric Administration (NOAA) for its handling of GOES meteorological satellites. The magazine maintained that the two agencies failed "in their effort to balance the risk of buying new technology with the need to provide assured satellite service." (*SP News*, Oct 7-13/91)

October 8: NASA announced that its newest Tracking and Data Relay Satellite, launched from Atlantis on August 2, 1991, was operational. This expanded the communications capability required by the increasing number of scientific spacecraft. (NASA Release 91-164; *Business Wire*, Oct 9/91)

- NASA further announced the selection of two additional Centers for the Commercial Development of Space (CCDS). These were the Center for the Commercial Development of Space in Satellite and Hybrid Communication Networks, University of Maryland Systems Research Center, College Park, and the Space Communications Technology Center, Florida Atlantic University Research Corporation, Boca Raton. In an unrelated action, NASA and Vanderbilt University, Nashville, Tennessee, agreed to discontinue the Center for Space Processing of Engineering Materials because of a decline in research by metals producers. (NASA Release 91-166; *B Sun*, Oct 10/91)

October 9: The *Christian Science Monitor* commended NASA for naming the orbiting Gamma Ray Observatory the Arthur Holly Compton Gamma Ray Observatory because of the late Nobel Prize laureate's studies of the subject. Moreover, the renaming focused attention on one of NASA's "outstandingly successful missions." (CSM, Oct 9/91)

- NASA announced the selection of new Regional Technology Transfer Centers to replace the Industrial Applications Centers whose contracts expire in 1991. The centers were the following: Northeast—Center for Technology Commercialization, Westborough, Massachusetts; Mid-Atlantic—University of Pittsburgh; Mid-West—Battelle Memorial Institute, Columbus, Ohio; Southeast—University of Florida, Alachua; Mid-Continent—Texas A and M University, College Station; and Far West—University of Southern California, Los Angeles. (NASA Release 91-167)

- NASA announced that the Antarctic ozone levels had reached the lowest values ever observed on October 6 (110, plus or minus 6), according to preliminary data from NASA's Goddard Space Flight Center, Greenbelt, Maryland. (NASA Release 91-168; *LA Times*, Oct 10/91)

- NASA Administrator Richard H. Truly met with senior NASA officials in Washington to discuss Deputy Administrator James R. Thompson's interim viewpoints on roles and responsibilities of NASA Centers and Headquarters offices. Thompson's final recommendations and a proposed implementation plan were to follow in early November. (NASA Release 91-169)

October 10: NASA announced that beginning October 12, 1992, 500 years after Columbus's discovery of America, NASA would begin the most comprehensive search ever for evidence of intelligent life elsewhere in the universe. The NASA Search for Extraterrestrial Intelligence (SETI) microwave project is to be a ground-based decade-long effort to detect microwave radio transmissions. (NASA Release 91-170; UPI, Oct 11/91)

- William J. O'Neil, manager of the \$1.4 billion Galileo project at NASA's Jet Propulsion Laboratory, said Galileo fired its thrusters to put it on a course to take it close to the asteroid Gaspia on October 29. (AP, Oct 10/91; *W Times*, Oct 10/91; *LA Times*, Oct 10/91)

- The speech of Lennard A. Fisk, NASA's Associate Administrator for Space Science and Applications, at a September 19 meeting of the American Institute of Aeronautics and Astronautics, was published in *Washington Technology*. Fisk first dealt with the causes and effects of negative publicity about NASA and went on to defend NASA's accomplishments and the rationale for NASA's existence as being an absolute rather than a relative one, which made developing a consensus harder. He concluded that "The adventure of space is a vital part of our society. The space program needs to be perceived as the best this country has to offer." (*Washington Technology*, Oct 10/91)

- According to the *Los Angeles Daily News*, NASA decided to modernize Space Shuttles Atlantis and Discovery in Florida rather than in Palmdale. This development, which was designed to save time and money, would cost the Antelope Valley of California more than 400 jobs. (*LA Daily News*, Oct 10/91)

October 11: The *Washington City Paper* carried an article featuring Ali Abutaha, whom it described as "telling NASA things it would rather not hear" over the preceding five years. He filed suit against NASA, Rockwell International (maker of the Shuttle's orbiter), and the American Institute of Aeronautics and Astronautics. However, the U.S. District Court in Alexandria, Virginia rejected his three suits. (*Washington City Paper*, Oct 11/91)

- The *Daily Press* recounted the dedication on October 10 of the 100-ton Variable Density Wind Tunnel as a National Historic Landmark. The ceremony occurred at NASA's Langley Research Center. The wind tunnel was responsible for more efficient wing designs of aircraft and established NASA's

predecessor, the National Advisory Committee for Aeronautics, as a technologically competent organization. (*Daily Press*, Oct 11/91)

October 13: A feature article in the *Los Angeles Times* discussed the changing qualifications for astronauts. In the early days of NASA, they were tough, independent male test pilots. More recently, they became better educated and diverse in backgrounds, men and women and of different ethnic origins. A second article described Mae Jemison, NASA's only black female astronaut. (*LA Times*, Oct 13/91)

October 14: The media reported the launch from Cape Canaveral by Orbital Sciences Corporation of a small Aries rocket carrying Star Wars experiments for the Defense Department. The experiments were intended to help in designing sensors to measure heat-emitting "signatures" of ballistic missiles in flight. (AP, Oct 14/91; *W Times*, Oct 15/91)

- Representative Howard Wolpe wrote in a space trade journal concerning the GOES-NEXT weather satellites. He commended Commerce Secretary Robert Mosbacher's statement that although GOES-NEXT would not be launched on schedule, it would meet original specifications. He continued to be concerned about a possible five-year gap without a weather detection system and stated that firm commitments of assistance must be obtained from Europe and Japan. He also criticized NASA for lacking a planned prototype instrument for GOES and for its ineffective cost controls. (*SP News*, Oct 14-20/91)

October 15: BDM Federal, Inc. president, Earle C. Williams, announced that the McLean, Virginia, firm won a contract to provide technical and management assistance for NASA's Earth Observing System Program. (PR Newswire, Oct 15/91)

- NASA Administrator Richard H. Truly announced the appointment of Paul F. Holloway as Director of the Langley Research Center, Hampton, Virginia. (NASA Release 91-171)

October 16: NASA announced that Pennsylvania State University's Center for Cell Research, State College, a NASA Center for the Commercial Development of Space, had begun a new space program to enable U.S. industry to enhance the purification and processing of cells, subcellular particles, proteins, growth factors, and other biological products. (NASA Release 91-172)

- NASA's Goddard Space Flight Center, Greenbelt, Maryland, announced the award of a contract to the Ball Corporation, Boulder, Colorado, to complete construction of the Corrective Optics Space Telescope Axial Replacement for the Hubble Space Telescope. (NASA Release C91-00; AP, Oct 16/91; PR Newswire, Oct 16/91; *B Sun*, Oct 17/91; *WSJ*, Oct 17/91)

October 17: NASA's Johnson Space Center, Houston announced the award of a contract to McDonnell Douglas Space Systems Company, Huntington Beach, California, modifying the Space Station Freedom Program Integration Support (Schedule B) contract. Schedule B involved the integration of Space Station components. (NASA Release C91-nn)

October 18: The American Institute of Aeronautics and Astronautics (AIAA) sponsored a workshop of scientists, environmentalists, regulators, and aerospace industry representatives the summer of 1991. As a result, a report was issued on October 17, concluding that rockets blasting into space generate pollutants that deplete stratospheric ozone, increase acid rain, contribute to global warming, and reduce air quality. Jerry Grey, science and technology policy director for the AIAA, said all nations that launch rocket-powered vehicles should contribute to an international effort to reduce the problems. The United States used more solid rockets than any other nation. For example, NASA estimated that each Space Shuttle flight deposited about 75 tons of chlorine into the ozone layer. Subsequently, Reuters interviewed Steve Newman, chief environmental engineer in NASA's Office of Space Flight. He admitted NASA played a minor role in depleting the ozone layer it was studying but said NASA was working to make its next generation of space vehicles more environmentally friendly. (*NY Times*, Oct 18/91; *B Sun*, Oct 28/91)

October 19: According to UPI, the new Shuttle Endeavour's maiden voyage in April 1992 faced a significant delay because of numerous problems discovered after it was delivered to the Kennedy Space Center. Among other reasons for the delay were the parts cannibalized from Endeavour to avoid major launch delays of other orbiters. As the Shuttle was inspected, more than 1,400 problem reports were filed regarding work needed. (UPI, Oct 19/91)

October 20: NASA scientists connected with the Hubble Space Telescope correction project were quoted with reference to the amount of work to be done. The Hubble science team, subject to top-level NASA approval, was to build a second generation Wide Field/Planetary Camera (WFPC) with only four instead of eight of the powerful electronic light detectors known as charge-coupled devices (CCDs). The proposed change took account of tight money and time pressures but meant that the photographic operation might take 10 to 20 percent longer, according to Ed Weiler, NASA's chief Hubble scientist. The extent of repairs to be made would be decided by the end of 1991 but probably would involve Shuttle astronauts making three or four spacewalks of at least six hours each. (*W Post*, Oct 20/91; *NY Times*, Oct 23/91; *USA Today*, Oct 23/91)

- Douglas Birch authored a feature article on the Hubble Telescope, its findings, and its limitations because of the flawed main mirror. Reportedly, the Hubble repair mission is to occur in November or December 1993.

Astronomers were also concerned about the telescope's age in terms of its effectiveness. Much of Birch's article centered on an interview with Douglas Duncan, an astronomer at the Space Telescope Science Institute on the campus of Johns Hopkins University, who used the Hubble telescope spectrograph data extensively. (*B Sun Magazine*, Oct 20/91)

- The *Washington Times* carried an article on Baikonur, the rocket workers' town in the Soviet Union founded by the military in 1955, the same year as the Cosmodrome. No permanent residents were registered in Baikonur, known as Leninsk, but the city had 100,000 inhabitants crammed into a 4.5 square mile area. Tables of Soviet "space firsts" and "space endurance records" were included. Another article in the same issue described Soviet efforts to sell or rent space gear, including parts of the orbiting Mir Space Station, to ease the financial situation of the space program.

A further article discussed China's space program, described as making "steady and substantial progress." Data varied concerning the cost of China's space efforts. According to the *Far Eastern Economic Review*, in May 1988 the annual cost was "about \$1.5 billion." Jiao Yong, a vice policy director with the Chinese Ministry of Aerospace Industry, told the *Hong Kong Standard* in May 1991 that China spent less than \$100 billion on aerospace over the previous 35 years. United States officials, however, estimated that China spent more than \$100 million per year on its commercial space industry alone. Commercial launch services included launching of communications satellites for other countries, such as Australia. In addition, according to *Interavia Space Markets*, a publication of the Jane's Information Group, China and Russia were the only countries offering recoverable satellites for microgravity experiments. China operated three major launching sites: Jiuquan Satellite Launching Center in northwest Gansu Province, Xichang Satellite Launching Center in southwest Sichuan Province, and Taiyuan Launching Center near the capital of Shanxi Province. (*W Times*, Oct 20/91)

October 21: A discussion of the robot explorer Magellan's probe of Venus during its 16 months and more than 3,000 orbits, mapping more than 90 percent of the surface, appeared in the *Washington Post*. Lead scientist Stephen Saunders of NASA's Jet Propulsion Laboratory in California, which manages the mission, was quoted as saying that scientists were looking for "active plate tectonics" such as "continental drifts" which occur on Earth. To date, no such discoveries have occurred. (*W Post*, Oct 21/91)

- NASA announced November 13 as the launch date for Consort 4, a commercial suborbital rocket carrying nine microgravity experiments. The experiments were to be launched from the Naval Ordnance Missile Test Station at White Sands Missile Range, New Mexico, with material from the University

of Alabama in Huntsville's Consortium for Materials Development in Space. (NASA Release 91-173)

- A trade publication reported that NASA Administrator Richard H. Truly had asked Vice President Dan Quayle to signal strong support to Congress for the X-30 National Aerospace Plane (NASP) program. NASA feared a major cut in funding of the NASP would significantly delay the program. (*AvWk*, Oct 21/91)

- The same publication discussed the way in which Michael Griffin, described as "NASA's new moon/Mars czar," was shaking up NASA's space exploration initiative. Reportedly, Griffin wanted to move fast on launching a "relatively inexpensive, high-visibility space mission," such as sending an unmanned spacecraft to scout for a permanent base on the moon. (*AvWk*, Oct 21/91)

October 22: Forrest McCartney, Director of the Kennedy Space Center at Cape Canaveral, said NASA might have to close one of its two Shuttle launch pads to save money. (*P Inq*, Oct 22/91)

- The United Nations (U.N.) reported that the world's ozone layer, particularly over the Antarctic, was thinner than ever and the "hole" over the Antarctic was increasing. However, U.N. scientist Ruman Bojkov said the U.S. Space Shuttle Challenger had not significantly contributed to the situation. Readings were taken by NASA satellites and ground-based spectrometers and the data analyzed by international scientists convened by the U.N. Environment Program and the World Meteorological Organization. Subsequently, Environmental Protection Agency Administrator William K. Reilly said "The problem is more serious than we believed." (UPI, Oct 22/91; *P Inq*, Oct 23/91; *W Post*, Oct 23/91; *USA Today*, Oct 23/91; *NY Times*, Oct 23/91; *WSJ*, Oct 23/91; *CSM*, Oct 23/91; *W Times*, Oct 23/91; *B Sun*, Oct 23/91; *LA Times*, Oct 23/91)

- AP quoted President Bush's science adviser, D. Allan Bromley, as saying that declassification of Star Wars technology would enable NASA to begin a \$30 billion study of Earth's environment earlier and cheaper. Bromley added that the Department of Defense and the Department of Energy would allow the use of some of their inventions for non-military purposes. The most important was a technology that allowed pointing an instrument from space with greater accuracy to a given spot on Earth and holding it, as well as a technique to fly individual satellites, bring them together, and lock them into formation so several satellites can look at the same spot on Earth. (AP, Oct 22/91)

- According to a local newspaper, a NASA/Ames research plane equipped with infrared scanners that can cut through smoke gave firefighters their first clear view of the intensity of the fire in the Oakland hills. A videotape of the

infrared data helped the firefighters and because the C-130B senses heat, not light, the NASA plane can provide information not available from firefighting helicopters. (*San Jose Mercury News*, Oct 22/91)

October 23: NASA announced that both Voyager spacecraft were still going strong after 14 years, more than two years after Voyager 2 observed Neptune. The two Voyagers were in a new phase, called the Voyager Interstellar Mission, searching for the outer edge of the solar system, the heliopause. (NASA Release 91-174)

- NASA announced the naming of M. Rhea Seddon as payload commander for Spacelab Life Sciences-2 Space Shuttle mission, scheduled for launch in July 1993. (NASA Release 91-175)

- Rockwell International Corporation stated that NASA had awarded it a three-year \$453.5 million contract extension to provide maintenance and repair for the Space Shuttles. (UPI, Oct 23/91)

- According to AP, the Hubble Space Telescope presents astrophysicists with a mystery: the existence of hydrogen clouds in space that should have dissipated billions of years ago. According to Ed Weiler, NASA's space telescope program manager, this was Hubble's most significant finding to date. (AP, Oct 23/91)

- *Florida Today* reported that Forrest McCartney, who had headed Kennedy Space Center since 1986, would be retiring in about a year. Subsequently, the media reported that McCartney had been asked to step aside early by top NASA managers. (*Fla Today*, Oct 23/91; UPI, Oct 25/91; AP, Oct 26/91; *W Times*, Oct 27/91; *O Sen Star*, Oct 30/91)

October 24: Space Shuttle Atlantis was slowly hauled to its launch pad for a scheduled November 19 blastoff, according to UPI. NASA announced its mission was to deploy a Defense Support Program satellite designed to detect nuclear detonations, missile launches, and space launches from a geosynchronous orbit. A number of other experiments are to be performed during the 10-day flight. (NASA Release 91-176; UPI, Oct 24/91)

- NASA announced that in conjunction with the Federal Aviation Administration it would sponsor an international government/industry workshop on aircraft icing. The workshop is to be held at NASA's Lewis Research Center in Cleveland, which has the Lewis Icing Research Tunnel, the world's largest refrigerated icing tunnel. (NASA Note to Editors N91-75)

October 25: The *Washington Post* highlighted Japan's rocket industry, which after 30 years of sending the country's own payloads into space, was prepar-

ing to win rights to launch foreign satellites. Its H-II was a heavy-lifter rocket, which should be ready for test flight in 1993, according to Hiroshi Imamura, executive vice president of Rocket System Corporation. (*W Post*, Oct 25/91)

- According to the press, two members of the House subcommittee that oversees NASA spending, Chairman Bob Traxler, Democrat of Michigan, and ranking minority member Bill Green, Republican of New York, asked NASA Administrator Richard Truly why NASA did not buy a Mir Space Station or other technology from the Soviet Union. NASA replied that the U.S. aerospace industry would not like it. (*AP*, Oct 25/91; *B Sun*, Oct 26/91; *LA Times*, Oct 27/91)

October 27: The media covered the Galileo's approach to the asteroid Gaspra, within which it was scheduled to fly 1,000 miles, making the first relatively close-up pictures of an asteroid. On October 29, Galileo took photographs of Gaspra as it flew by, but because its main antenna remained jammed the images could not be transmitted until the malfunction was fixed. (*NY Times*, Oct 27/91; *W Times*, Oct 28/91; *P Inq*, Oct 28/91; *W Post*, Oct 30/91; *P Inq*, Oct 30/91; *B Sun*, Oct 30/91; *O Sen Star*, Oct 30/91; *Fla Today*, Oct 30/91; *H Chron*, Oct 30/91; *H Post*, Oct 30/91; *C Trim*, Oct 30/91; UPI, Oct 30/91)

October 28: NASA announced that Dudley McConnell, Associate Director for Applications for NASA's Earth Science and Applications Division, died of an apparent heart attack. (NASA Obituary; *Fla Today*, Oct 29/91; *W Post*, Oct 31/91)

- NASA announced that it and other institutions such as the National Center for Atmospheric Research in Boulder, Colorado, the National Oceanic and Atmospheric Administration, and a number of universities had begun a six-month airborne study to determine the probability that an ozone "hole," similar to the annual phenomenon seen in the Antarctic, would develop in the Northern Hemisphere. (NASA Release 91-178; *Fla Today*, Oct 29/91)

- Quoting the *Dallas Times Herald*, AP reported on a study being done for NASA by Dr. Charles Pak, head of the Mineral Metabolism Department at the University of Texas Southwestern Medical Center in Dallas. According to Pak, white males might not be able to withstand long trips in space because their bones tend to deteriorate during extended weightlessness. Young black men were the best candidates for long-term space travel because women, who have smaller bone structure, also lose bone more rapidly. Dr. Stanley Feld, clinical professor at the Medical Center and head of endocrinology at the Presbyterian Hospital, said the important thing was to find ways to stop bone loss in space. (*AP*, Oct 28/91; *Fla Today*, Oct 29/91)

- According to *Florida Today*, the Atlantis astronauts were scheduled to arrive at Kennedy Space Center in a few days, to begin preparations and a practice countdown for the Space Shuttle flight. (*Fla Today*, Oct 28/91; UPI, Oct 31/91)

October 30: James T. Rose, Assistant Administrator for Commercial Programs, announced his plan to leave NASA. NASA Administrator Richard H. Truly announced that John G. Mannix would take his place. (NASA Release 91-179)

- NASA Administrator Richard Truly spoke on the opening day of the Space Exploration '91 convention in Houston, sponsored by the NASA Alumni League. He said that recent successes by unmanned missions were paving the way for future space initiatives. He also stressed the need for belt tightening over the next several years. (*H Post*, Oct 30/91; *H Chron*, Oct 30/91)

- NASA unveiled a three-dimensional view of Venus created from images recorded by the Magellan spacecraft. Magellan detected a five-mile high volcano known as Maat Mons, about the size of Earth's largest volcano, Hawaii's Mauna Kea. (*P Inq*, Oct 30/91; *W Post*, Oct 30/91; *NY Times*, Oct 30/91; *W Times*, Oct 30/91; *NY Times*, Oct 30/91; *Fla Today*, Oct 30/91; *C Trin*, Oct 30/91; AP, Oct 30/91)

- *Florida Today* published figures of Kennedy Space Center spending for the fiscal year ending September 30, 1991. The center spent \$1.42 billion in Florida, an increase of 3.6 percent over the previous year. Of that amount, \$1.03 billion went for on-site contractors. (*Fla Today*, Oct 30/91)

October 31: NASA Administrator Richard H. Truly named Robert L. Crippen as the new Director of the John F. Kennedy Space Center, effective January 1, 1992. Crippen is to replace Forrest S. McCartney. (NASA Release 91-180; AP, Oct 31/91; UPI, Oct 31/91; *O Sen Star*, Nov 1/91; *Fla Today*, Nov 1/91)

November

November 1: NASA announced that it had reached agreement with Columbia Communications Corporation, Honolulu, to delay for up to six months the start of operations under Columbia's lease of NASA's Tracking and Data Relay Satellite System (TDRSS) C-Band capacity. NASA leased to Columbia the C-Band transponders on two geostationary TDRSS satellites to serve commercial international telecommunications customers in the Atlantic and Pacific coastal regions. (NASA Release 91-181)

- The media reported that on October 31, a Federal grand jury in Iowa had indicted the Rockwell International Corporation and two of its employees on charges of overbilling NASA for work on the Space Shuttle program. On November 8, NASA announced its suspension of Collins Commercial Avionics, Cedar Rapids, Iowa, a division of Rockwell International from further government contracts because of the indictment. (*NY Times*, Nov 1/91; *WSJ*, Nov 1/91; *P Inq*, Nov 1/91; *B Sun*, Nov 1/91; *W Times*, Nov 1/91; AP, Nov 1/91; UPI, Nov 1/91; NASA Release 91-186; AP, Nov 9/91; *Fla Today*, Nov 11/91; *W Post*, Nov 11/91; *WSJ*, Nov 11/91; UPI, Nov 11/91)

- The *Philadelphia Inquirer*, quoting AP, reported that a hydraulic fuel tank in one of Space Shuttle Atlantis's solid rocket boosters burst after a test on October 31. However, according to NASA spokeswoman Lisa Malone, the rupture should not delay the scheduled launch of Atlantis. (*P Inq*, Nov 1/91)

- The media discussed Forrest McCartney's being asked by NASA to step aside as head of the Kennedy Space Center so that he could be replaced by Robert Crippen. McCartney said he would have liked to stay on another year, but this was not possible. (*W Post*, Nov 1/91; *W Times*, Nov 1/91; *Fla Today*, Nov 1/91; *O Sen Star*, Nov 1/91; AP, Nov 1/91; *P Inq*, Nov 2/91; UPI, Nov 2/91; *NY Times*, Nov 3/91; *SP News*, Nov 4-10/91; *O Sen Star*, Nov 9/91)

November 3: An AP article discussed NASA's Fort Lightning, near Cape Canaveral, where Bill Jafferis manages NASA's lightning research process. By greater understanding of lightning, forecasting could be improved, thus reducing interruptions and delays in Shuttle launches and saving money, equipment, and lives. (*W Times*, Nov 3/91)

November 4: NASA announced that undergraduate engineering students at Mississippi State University, Starkville, had won the competition to build a 50-foot mockup of the X-30/National Aerospace Plane. (NASA Release 91-182; *Fla Today*, Nov 10/91)

- In repositioning one of NASA's Tracking and Data Relay Satellites, TDRS-3, on October 22, it came near a Hughes Communications' Galaxy 1. On October 23, it disturbed GE Americom's Satcom 1R. The result was that cable television nationwide was disrupted. NASA Associate Administrator Charles T. Force said engineers suspected a hardware failure on TDRS caused the problem. (*AvWk*, Nov 4/91)

November 5: NASA announced the successful testing of a new method to measure surface pressure on airplanes during flight; such information provides data for improving plane designs. NASA tests used paint that becomes iridescent under ultraviolet light. The intensity of the light radiated by the paint, as seen in photographs, results from the flight pressure. (NASA Release 91-183; *Antelope Valley Press*, Nov 8/91)

- Hughes Aircraft Company said its Space and Communications Group had signed a \$300 million contract to build three communications satellites for Alpha Lyracom, a private global communications satellite operator. The first satellite was scheduled for launch in May 1994 and is to serve the Pacific Ocean region. (*WSJ*, Nov 5/91)

November 6: Findings presented at the American Astronomical Society's Division of Planetary Sciences conference suggested that Mercury had an ice cap on its north pole, even though it was the planet nearest the sun. The findings surprised the California Institute of Technology scientists who discovered them and were based on August experiments, the first radar photographs of an entire hemisphere of Mercury. The brightest reflection on the planet's north pole indicated a highly reflective substance such as ice over an area of an estimated 150 square miles. (*AP*, Nov 6/91; *B Sun*, Nov 7/91; *P Inq*, Nov 8/91; *LA Times*, Nov 11/91)

November 7: NASA announced that November 19 had been set for the launch of Space Shuttle Atlantis, which would carry a full load of military and scientific experiments during its 10-day mission. Of major importance would be its deployment of the latest in a series of Defense Support Program reconnaissance satellites. (NASA Launch Advisory; *AP*, Nov 7/91; *UPI*, Nov 8/91)

- NASA announced the selection of 301 research proposals (from 2,583 received) for immediate contract negotiation in NASA's 1991 Small Business Innovation Research Program. While meeting federal research and development needs, the program aims to stimulate technological innovation. (NASA Release 91-184)

- NASA Administrator Richard H. Truly announced the award of the George M. Low Trophy, recognizing the best contractors on the space program, to Grumman Technical Services Division, Titusville, Florida, and

Thiokol Corporation, Space Operations, Brigham City, Utah. Grumman provided hardware and support services to the integrated launch team at the Kennedy Space Center, Florida. Thiokol provided the redesigned solid rocket motor propulsion system that produced 80 percent of the thrust necessary for Space Shuttle liftoff. (NASA Release 91-185; PR Newswire, Nov 7/91)

- NASA's Johnson Space Center announced the award to McDonnell Douglas Space Systems Company, Huntington Beach, California, of a modification to the Space Station Freedom Schedule A contract. Schedule A provided hardware components for the Space Station and the modification will encompass the Integration, Test, and Verification Environment and Ada Compiler. (NASA Release C91-pp)

November 8: AP reported that NASA found a way to circumvent the jammed antenna on Galileo in order to receive photographs of the Gaspra asteroid. Images were being sent with the smaller antenna at a very slow rate. (AP, Nov 8/91; *B Sun*, Nov 9/91)

November 9: The *Baltimore Sun* reported a NASA announcement on November 8 that its \$10 million effort to determine whether a hole in the Earth's protective ozone layer was developing over the North Pole, was delayed by mechanical problems in both the project's aircraft. Mike Kurylo, manager of NASA's Upper Atmosphere Research Program, said the DC-8 jet had a crack in its landing gear and the high-altitude ER-2 aircraft was grounded for a problem with its wings. In addressing the same subject, the *New York Times* quoted the project's chief scientist as saying three ER-2 planes would be used to survey the ozone layer at high altitudes. (*B Sun*, Nov 9/91; *NY Times*, Nov 10/91)

- The *Baltimore Sun* quoted Anne Thompson, an atmospheric scientist at NASA's Goddard Space Flight Center with reference to the interconnectedness of the atmosphere's mounting problems: global warming, ozone depletion, and smog. As examples she pointed out that some hydroxyl-enhancing gases contributed to acid rain; others contributed to the greenhouse effect, while at the same time, hydroxyl played a vital role in stemming depletion of the Earth's ozone layer. (*B Sun*, Nov 9/91)

November 10: The media quoted *Aviation Week and Space Journal* magazine as saying that a \$70 million cost overrun had doubled the price of two NASA spacecraft being developed to study the interaction between the Earth and the Sun. The craft were being built for use in the 17-nation International Solar Terrestrial Physics Program. NASA officials reportedly confirmed the cost increases. (AP, Nov 10/91; *W Times*, Nov 11/91; *Fla Today*, Nov 11/91; *B Sun*, Nov 11/91)

November 11: Dramatic pictures were published of NASA spacecraft Magellan's findings on Venus. These included several of a peak that may be an

active volcano surrounded by fresh lava, as well as the first global map of Venus. (*Newsweek*, Nov 11/91)

November 12: The British journal *Nature* carried an article by Rodney A. Viereck and Edmond Murad of Phillips Laboratory, a space research center at Hanscom Air Force Base, Bedford, Massachusetts. Their findings indicated that the probable reason for the eerie orange glow of the Shuttles was caused by oxygen in the upper atmosphere striking nitric oxide on the Shuttle's skin, forming excited nitrogen dioxide, which radiates light when it moves off the surface. (*NY Times*, Nov 12/91; *Xinhua*, Nov 12/91)

- NASA announced that its latest target in efforts to understand the global climate and predict future patterns are the cirrus clouds. In mid-November, atmospheric scientists from NASA's Langley Research Center, Hampton, Virginia, to lead were researchers to Coffeyville, Kansas, where ground, airborne, and satellite measurement platforms were to conduct intensive cirrus cloud investigation for 25 days. (NASA Release 91-187)

- Orbital Sciences Corporation, Fairfax, Virginia, announced the appointment of former NASA Deputy Director J.R. Thompson Jr. as executive vice president. He was to manage the new Orbital office in Huntsville, Alabama, near Marshall Space Flight Center. (*AP*, Nov 12/91; *W Post*, Nov 13/91; *W Times*, Nov 13/91; *Htsvl Tms*, Nov 13/91; (*Northern Virginia*) *Journal*, Nov 14/91)

November 13: A University of Alabama, Huntsville-managed sounding rocket launch was canceled on November 12 when an electrical problem occurred with one experiment. The launch of the Consort 4 from the White Sands New Mexico Missile Range was reset for November 16. (*Htsvl Tms*, Nov 13/91; *AP*, Nov 13/91)

- The Air Force Eastern Space and Missile Center became the 45th Space Wing on November 12. The East Coast launch organization was responsible for facilities at Patrick, Cape Canaveral, Antigua, and Ascension. (*Fla Today*, Nov 13/91)

November 14: NASA announced that its research plane F-16XL demonstrated laminar airflow over a significant part of its wing while flying at supersonic speeds. This could increase flight efficiency and reduce fuel consumption. The experiment occurred in a series of 28 flights at NASA's Ames-Dryden Flight Research Facility, Edwards, California. In this connection, the *New York Times* wrote about wind shear problems faced by aircraft, leading to airline disasters, and NASA's work on three predictive systems made by Lockheed Corporation, Rockwell International, and Turbulence Prediction Systems. (NASA Release 91-188; *Daily Press*, *Newport News*, Nov 20/91; *Antelope Valley Press*, Nov 21/91; *NY Times*, Nov 24/91)

- NASA released the first photograph of an asteroid, that of Gaspia, taken by Galileo October 29. (NASA Release 91-189; UPI, Nov 14/91; *W Post*, Nov 15/91; *NY Times*, Nov 15/91; *W Times*, Nov 15/91; *USA Today*, Nov 15/91; *B Sun*, Nov 15/91; *LA Times*, Nov 15/91; *P Inq*, Nov 15/91; AP, Nov 15/91)

- NASA Administrator Richard H. Truly released an internal Agency report on roles and responsibilities of NASA Centers and Headquarters offices, prepared by former Deputy Administrator James R. Thompson. Thompson focused on three thrusts: building on NASA field organizations as Centers of Excellence in specific areas of science, technology, and development; a reminder to “stick to basics” in engineering disciplines, and program management, and realignments of certain NASA Headquarters office responsibilities to achieve more efficient program execution. (NASA Release 91-190; AP, Nov 15/91)

- An article in *Florida Today* referred to former NASA Deputy Administrator J.R. Thompson’s proposal that some 100 top Shuttle program managers around the country be moved to Kennedy Space Center under a consolidation plan NASA was considering. The recommendations were to be discussed at a December 9-10 meeting with NASA Administrator Richard Truly. (*Fla Today*, Nov 15/91)

November 15: NASA announced the holding of a second national technology transfer conference at the San Jose Convention Center, December 3-5. Sponsored by NASA and the Technology Utilization Foundation, Technology 2001 would showcase leading-edge technologies from the Space Agency and other Federal agencies. (NASA Release 91-191)

- Arnold Aldrich, Associate Administrator for NASA’s office of Space Systems Development, met with all staff at the Reston, Virginia Space Station Freedom office. He said NASA intended to maintain a strong and effective team at Reston during the Space Station Freedom development period. (NASA Release 91-192; (*Northern Virginia Journal*, Nov 15/91; *W Post*, Nov 16/91; *Washington Technology*, Nov 21/91)

November 16: AP reported that after a delay caused by a battery failure in one of the experiments, a three-ton Starfire 1 rocket blasted off from the White Sands Missile Range, New Mexico. After its 15-minute flight peaking at 185 miles above Earth, researchers recovered the rocket’s payload in the missile range 50 miles from the launch pad. The rocket spent seven minutes in micro-gravity, an area of little gravity on the edge of space, where nine experiments were conducted. (AP, Nov 16/91)

November 17: The media gave extensive coverage to preparations for the launch of Shuttle Atlantis, scheduled for November 19. Coverage included mention of a “spy camera” designed to take detailed pictures of installations on

Earth from space. (*P Inq*, Nov 17/91; *W Times*, Nov 17/91; *USA Today*, Nov 18/91; *B Sun*, Nov 18/91; *W Times*, Nov 18/91; *NY Times*, Nov 18/91; *C Trin*, Nov 18/91; *LA Times*, Nov 18/91; *AP*, Nov 18/91; *UPI*, Nov 18/91; *NY Times*, Nov 19/91; *USA Today*, Nov 19/91; *W Post*, Nov 19/91; *UPI*, Nov 19/91)

- The *Huntsville Times* indicated that NASA and consumers in general had much in common, namely a situation of being caught in a recession when careful budgeting was necessary. Nonetheless, many NASA programs, such as Magellan's probe of Venus, and the Hubble Space Telescope, were continuing their good work. (*Htsul Tms*, Nov 17/91)

November 18: The *Washington Post* featured the space biology team at NASA's Johnson Space Center in Houston, which has created a stir with a government-patented invention that allows large quantities of many types of human cells to be grown by removing the force of gravity. NASA's Rotating Wall Bioreactor had great potential for improving patient treatment and may grow still more cells when used in space. In this connection, NASA announced that the rotating wall vessel developed at the Johnson Space Center's Biotechnology Program, would be tested in space during the Atlantis flight. (*W Post*, Nov 18/91; NASA Release 91-195)

- Thirteen European countries—Austria, Belgium, Britain, Denmark, France, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden, and Switzerland—met to discuss European Space Agency plans that were threatened by Germany's lack of funds. The German research budget was short \$930 million because of an economic slowdown and the huge costs of German unification. The space agency's German Ariane rocket boosted at least 17 satellites into space and according to Germany's ZDF television network, was assured of funds. The question of funds for other projects, for which Germany and France were major funders, remained unclear. (*AP*, Nov 18/91; *Science and Technology*, Nov 25/91)

- Robert Brown and Riccardo Giacconi of the Space Telescope Science Institute in Baltimore wrote an article favoring NASA's shift toward a more balanced program of small, intermediate, and large missions. The reason was that important research goals must be pursued with appropriate tools, including large spacecraft. For example, the Hubble Space Telescope, which was proving so valuable, needed a larger spacecraft as was to be the case with the Advanced X-ray Astrophysics Facility under development. (*SP News*, Nov 18-24/91; *NY Times*, Nov 24/91)

- A space journal reported that Vice President Dan Quayle had asked David Thompson, former NASA engineer and current chairman, president, and chief executive officer of Orbital Sciences Corporation of Fairfax, Virginia, to take the post of NASA Deputy Administrator. Thompson was considering the matter. (*SP News*, Nov 18-24/91)

November 19: The *Washington Post* highlighted NASA's encouragement of education and research by its so-called Get Away Special (GAS) program in which it carried space experiment canisters into space for nominal fees. The cost, set in 1976, ranged from \$3,000 to \$10,000, depending on the canister size. However, these fees recently were more than doubled, making them prohibitive for many educational institutions. Robert Tucker, NASA's Director of Space Transportation Services, indicated that neither the old nor the new prices represented the true cost, which NASA subsidized. (*W Post*, Nov 19/91)

- NASA announced the selection of seven Historically Black Colleges and Universities to receive Core Research Center grants to develop further their research capability and research infrastructure. The institutions were: Clark Atlanta University, Atlanta; Fisk University, Nashville; Florida A&M University, Tallahassee; Hampton University, Hampton, Virginia; Howard University, Washington, D.C.; North Carolina A&T State University, Greensboro; and Tuskegee University, Tuskegee, Alabama. (NASA Release 91-193)

- NASA officials told UPI that a 1993 Shuttle flight would end with a fully automatic, hands-off landing to test untried systems that might be needed if pilots were not up to the task after a long-duration mission. (UPI, Nov 19/91)

November 20: On the night of November 19, NASA delayed the launch of Atlantis for at least five days because of the malfunction of a navigation unit in the satellite rocket that provided liftoff. (*P Inq*, Nov 20/91; *NY Times*, Nov 20/91; *W Post*, Nov 20/91; *USA Today*, Nov 20/91; *LA Times*, Nov 20/91; AP, Nov 20/91; UPI, Nov 20/91)

- A mysterious object was scheduled to fly near Earth in December. Scientists do not know whether it is a new type of asteroid or a 20-year-old Apollo rocket that shot past the moon and was returning home. Subsequently, it was reported to be a tiny asteroid in circular Earth orbit. However, further reporting by another team of observers indicated it was more probably a cartwheeling rocket carcass. (*W Times*, Nov 20/91; *NY Times*, Nov 20/91; *USA Today*, Nov 21/91; *P Inq*, Dec 1/91; *W Post*, Dec 9/91)

- A U.N.-sponsored study, the committee for which was co-chaired by Robert Watson, a NASA scientist, provided the first evidence of a summertime thinning of the Earth's protective ozone layer over parts of the Northern Hemisphere, including the United States. The findings were based on both ground and satellite data, according to Watson in a briefing. Evidence showed three percent of the summertime ozone layer and six percent of the wintertime ozone layer were lost over the middle-latitude regions during the 1980s; similar results were expected for the 1990s.

In connection with the ozone depletion, chemist Jim Anderson of Harvard University, together with some 120 scientists from six universities, NASA, and two national laboratories, was preparing to launch a \$10 million research expedition of 50 airplane flights over the Arctic. Scientists also proposed planes spraying 50,000 tons of propane or ethane high over the South Pole as a possible way to neutralize the Antarctic ozone hole. (UPI, Nov 20/91; *P Inq*, Nov 22/91; *W Post*, Nov 25/91; *NY Times*, Nov 26/91)

November 21: Robert Brown and Paul A. Vanden Bout, astronomers at the National Radio Astronomy Observatory in Charlottesville, Virginia, using the 12-meter telescope on Kitt Peak, Arizona, in July discovered carbon monoxide in a strange object previously found by researchers in Ursa Major. A huge gas cloud, at the fringe of the universe, it might be linked to a galaxy in formation. (*P Inq*, Nov 21/91; *LA Times*, Nov 25/91)

November 22: NASA announced that the University of Alabama in Huntsville's Consortium for Materials Development in Space, a NASA Center for the Commercial Development of Space, had selected EER Systems Corporation, Vienna, Virginia, to provide vehicle, launch, and recovery services for the next series of Consort suborbital rocket missions. (NASA Release 91-194)

November 23: At a news conference at Goddard Space Flight Center, researchers from NASA and from the Soviet Central Aerological Observatory near Moscow announced the success of the first U.S.-Soviet space effort in 16 years. The engineer's model of the first Total Ozone Mapping Spectrometer (TOMS—U.S. technology-transfer laws prohibited the launch of a state-of-the-art TOMS aboard a Soviet satellite) was launched aboard a Soviet satellite August 15, and was sending back "high-quality data," according to Soviet Deputy Director Vyacheslav Khattatov. (*B Sun*, Nov 23/91; *NY Times*, Nov 23/91)

- NASA's proposed launch on Columbus Day 1992 of an extended Search for Extra-Terrestrial Intelligence (SETI) was described in some detail. SETI's seven-year duration was to have two phases, a "targeted search" directed from NASA's Ames Research Center in Mountain View, California, using the world's largest radio telescope in Arecibo, Puerto Rico, and an all-sky survey, run by the Jet Propulsion Laboratory in Pasadena over a five-year period, beginning with NASA's Deep Space Network radio observatory in Goldstone, California. (*B Sun*, Nov 23/91; *P Inq*, Nov 25/91; *W Times*, Nov 29/91)

November 25: Media coverage of the launch of Space Shuttle Atlantis on November 24 and the release of a \$300 million Air Force early warning satellite on November 25 was extensive. Reports thereafter concentrated on the experiments conducted by the astronauts aboard the Shuttle, including spotting preselected Earth sites from space. On November 28, Atlantis maneuvered out of the way of a chunk of a Soviet rocket. (*B Sun*,

Nov 25/91; *NY Times*, Nov 25/91; *W Post*, Nov 25/91; *W Times*, Nov 25/91; *USA Today*, Nov 25/91; *P Inq*, Nov 25/91; *WSJ*, Nov 25/91; AP, Nov 25/91; UPI, Nov 25/91; *NY Times*, Nov 26/91; AP, Nov 26/91; *B Sun*, Nov 27/91; *USA Today*, Nov 27/91; *C Trin*, Nov 27/91; AP, Nov 27/91; UPI, Nov 27/91; *B Sun*, Nov 28/91; *NY Times*, Nov 28/91; *W Times*, Nov 28/91; UPI, Nov 28/91; *B Sun*, Nov 29/91; *P Inq*, Nov 29/91; *W Times*, Nov 29/91; *USA Today*, Nov 29/91; *LA Times*, Nov 29/91; UPI, Nov 29/91; *W Post*, Nov 30/91)

- A feature article dealt with NASA's management overhaul, which it described as nearly complete and based on recommendations of Congress, the Augustine panel, and the most recent report of former Deputy Administrator J.R. Thompson. (*W Post*, Nov 25/91)

- The *Los Angeles Times* described at some length the Yellow Creek Advanced Solid Rocket Motor Facility, to be located on the Tombigbee Waterway of the Tennessee Valley Authority, in the home district of Jamie L. Whitten, chairman of the House Appropriations Committee. The \$3 million project was to introduce a solid rocket system that was mandated by Congress but which NASA's advisory panel said was not needed and might not be as reliable as existing systems. The unemployment rate in this district of northern Mississippi was more than 20 percent, and critics maintained this was the reason for the facility being constructed here. (*LA Times*, Nov 25/91)

November 26: The media reported that the National Space Council decided that the new Landsat satellite to study environmental changes on Earth and military movements, Landsat VII, would be funded by NASA and the Defense Department. Landsat VII was to resemble Landsat VI, which was scheduled for launch in late 1992. NASA Administrator Richard Truly testified at a congressional hearing on the subject November 26. (*WSJ*, Nov 26/91; AP, Nov 26/91; *W Times*, Nov 27/91)

- NASA announced that the first demonstration of digital radio broadcasting via satellite to a mobile vehicle would occur December 2-6 in Washington, D.C. The presentation represented a joint effort of NASA and the U.S. Information Agency's Voice of America. (NASA Release 91-196)

November 28: The *Baltimore Sun* discussed a cooperative program between NASA and the Italian Space Agency, which was to supply the satellite. The program involved a tethered satellite, a concept developed by engineers at Martin Marietta Corporation. Martin Marietta developed the boom that was to deploy the satellite, which would be connected to the Shuttle by a long "string" or cable. The first mission was to include an electrodynamic test in which the satellite and tether were to be used to generate electricity. (*B Sun*, Nov 28/91)

November 29: NASA announced that its John F. Kennedy Space Center, Florida, had awarded EG&G Florida, Inc., a one-year extension of its contract for base operations services. (NASA Release C91-qq)

December

December: An article in *Air Combat* dealt with NASA's use of the Lockheed SR-71A Blackbird, which the military retired from use. Several top military officers commented that the Blackbird and its unique capabilities would have been useful in the Persian Gulf War in updating the military's constantly changing battle plans. NASA used its three YF-12As, the predecessors of the SR-71As, in the 1970s and got much data on high-speed flight. Currently, NASA was using its SR-71As similarly because they were excellent for testing equipment and new materials in a moderately high (compared to the Mach 25 of the X-30) speed range. Thus, the SR-71As would be useful to test materials for the X-30, which was being developed. (*Air Combat*, Dec 91)

- According to a feature article in the *Aviation Safety Journal*, a major way for pilots to learn how to respond to emergency situations was through the Aviation Safety Reporting System (ASRS). This system, initiated by the Federal Aviation Association in 1975, enabled pilots to profit from the experience of others. (*Aviation Safety Journal*, Fall 91)

- NASA's Kevin Tucker described NASA's role in its Aviation Safety and Automation (AS/A) program. Begun in 1989, the program was to develop a technology to improve the safety of the national airspace system, by maximizing effectiveness and safety of automation without compromising human authority. (*Aviation Safety Journal*, Fall 91)

December 1: Media coverage was extensive of NASA's cutting short by three days the mission of Space Shuttle Atlantis because of a failed navigational unit. Atlantis landed at Edwards Air Force Base, California, December 1. The Shuttle landed in good condition although it lost a small electrical connector part on landing. (*W Post*, Dec 1/91; *W Times*, Dec 1/91; *NY Times*, Dec 1/91; *B Sun*, Dec 1/91; *P Inq*, Dec 1/91; *P Inq*, Dec 2/91; *NY Times*, Dec 2/91; *W Post*, Dec 2/91; *W Times*, Dec 2/91; *B Sun*, Dec 2/91; *USA Today*, Dec 2/91; *AP*, Dec 2/91; *C Trin*, Dec 2/91; *UPI*, Dec 2/91; *B Sun*, Dec 3/91; *NY Times*, Dec 3/91; *W Times*, Dec 3/91; *USA Today*, Dec 3/91)

December 2: A spy satellite monitoring center, officially known as the Onizuka Air Force Base, near Sunnyvale, California, needed no longer to be considered top secret. The center controlled 80 Pentagon military and spy satellites but this responsibility was gradually being transferred to the Consolidated Space Operations Center at Falcon Air Force Base in Colorado. According to a government report, the transfer would not be complete until 1993. (*LA Times*, Dec 2/91)

- An editorial in a space journal advocated that NASA wind down its program for the construction of the National Aerospace Plane, the X-30, for

which it has no funds, rather than wait until 1993 to decide. Instead the journal advocated NASA's focusing on "research and development that would continue its already impressive advances in materials and propulsion technology." (*SP News*, Dec 2-8/91)

December 4: NASA announced that a soccer ball-shaped carbon molecule might be the perfect propellant for a spacecraft engine that produced thrust by expelling charged atoms or molecules. Stephanie D. Leifer, an engineer at NASA's Jet Propulsion Laboratory, Pasadena, and Winston A. Saunders of the California Institute of Technology proposed to use the molecule Carbon 60 as a fuel in ion engines. (NASA Release 91-197)

- NASA Administrator Richard H. Truly announced the appointment of H. Lee Beach Jr. as Deputy Director of the Langley Research Center, Hampton, Virginia. (NASA Release 91-198)

- NASA's Search for Extraterrestrial Intelligence (SETI) program was featured in the *Christian Science Monitor*. Harvard University professor Paul Horowitz, designer of the Planetary Society equipment, was cited as an enthusiastic listener for signals from space over the past eight years. (CSM, Dec 4/91)

December 5: NASA announced that early results from its Upper Atmosphere Research Satellite (UARS) confirmed the link between the presence of chlorine monoxide and the depletion of ozone in Earth's upper atmosphere. The UARS was launched by Space Shuttle Discovery on September 12, 1991. (NASA Release 91-199)

- The *Antelope Valley Press* reported on NASA's testing of extensively modified F-16 jets as the first swept-winged aircraft to make laminar flow flights at supersonic speeds. Laminar flow was the even travel of air over an aircraft's surface when in flight. The tests would provide useful data for avoiding turbulence in commercial airline flights. (*Antelope Valley Press*, Dec 5/91)

- NASA Associate Administrator Spence Armstrong met with Marshall Space Flight Center officials on December 4. He said NASA's programs put it in a good position to continue to attract top engineering talents. NASA would need to attract engineers from several previously underrepresented groups, including blacks, women, the disabled, and other minorities. (*Htsvl Tms*, Dec 5/91)

December 6: NASA announced that the Italian Space Agency (ASI) would design and develop two Mini Pressurized Logistics Modules for Space Station Freedom under a memorandum of understanding signed with NASA in Washington. NASA Administrator Richard H. Truly signed on behalf of NASA and Luciano Guerriero, President of ASI, signed on its behalf. The

two agencies also agreed to work toward expanding their relationship, including the provision of a Mini Laboratory. (NASA Release 91-200)

- NASA's Johnson Space Center, Houston, announced the award of an extension to the United Technologies Corporation's Hamilton Standard Division's Extravehicular Mobility Unit hardware contract. (NASA Release C91-rr)

- NASA announced the naming of two additional NASA astronauts and three payload specialists to the crew for the Spacelab Life Sciences-2 mission, set for launch in mid 1993. (NASA Release 91-201)

- NASA held a news briefing designed to show that Space Station Freedom was back on track. NASA Administrator Richard Truly indicated that the final design of the station would be streamlined in weight and electrical power and would rely on robots for repairs. (*USA Today*, Dec 6/91; *W Post*, Dec 6/91; *W Times*, Dec 6/91; AP, Dec 6/91)

December 7: An Atlas-2 rocket boosted an \$85 million European Telecommunications Satellite Organization (Eutelsat) 2 communications satellite into orbit from Cape Canaveral. The satellite was the third in a series of French-built relay stations designed to route television and radio telephone signals across Europe. (UPI, Dec 7/91)

- Space Shuttle Atlantis, mounted atop NASA's Boeing 747 Shuttle carrier, began its two-day flight back to Kennedy Space Center in Florida. (AP, Dec 7/91; *W Times*, Dec 8/91)

December 9: AP reported that statistically it was inevitable that astronauts would be obliged to make detours to avoid space junk. It happened twice within the previous three months, most recently with Atlantis a week and a half earlier, when it had to dodge 3,200 pounds of rocket debris. Under mission rules adopted after the Challenger explosion in 1986, astronauts must distance themselves from orbiting objects if they are expected to pass within a security zone that is 3.1 miles long, 1.2 miles wide, and 1.2 miles deep. NASA estimated there was one chance in 100,000 that a detectable object would collide with a spacecraft once inside that zone. (AP, Dec 9/91; *NY Times*, Dec 10/91)

December 10: Sam F. Iacobellis, executive vice president and chief operating officer of Rockwell International Corporation, presented a check for \$87,500 to the Challenger Center for Space Science Education to support a national educational teleconference to be aired in the fall of 1992 on Discovery Networks. (Business Wire, Dec 10/91; *LA Times*, Dec 12/91)

December 11: The *Washington Post*, quoting Edward Weiler, NASA's chief Hubble Space Telescope scientist, said that a computer programming error

caused the Hubble to shut itself down temporarily on December 9. The problem was not considered serious and should result in losing only two days of scientific observations. NASA announced on December 12 that the Hubble resumed science data collection as of that morning and returned safely from its standby condition or safe mode, a capability built into all NASA spacecraft. In connection with the Hubble, the *Baltimore Sun* reported a problem with its spectrograph, which NASA believed it solved by leaving the power supply units for both ultraviolet detectors on all the time. (*W Post*, Dec 11/91; UPI, Dec 11/91; AP, Dec 11/91; *W Times*, Dec 12/91; NASA Release 91-204; *C Trin*, Dec 12/91; *W Post*, Dec 13/91; *B Sun*, Dec 13/91)

- NASA announced the award to members of three Space Shuttle crews of the Vladimir M. Komarov Diploma by the National Aeronautic Association for their "outstanding achievements in the field of exploration of outer space." The awards were from the Council of the Federation Aeronautique Internationale. The crews receiving the awards were the January 1990 STS-32 mission, which retrieved the Long Duration Exposure Facility; the December 1990 STS-35 mission, which carried the ASTRO-1 astrophysics observatory; and the October 1990 mission STS-41, which deployed the joint NASA/European Space Agency's Ulysses spacecraft to study the sun. (NASA Release 91-202 Revised; *Fla Today*, Dec 15/91)

- NASA announced a recent agreement between its Office of Commercial Programs and the University of Alabama, Huntsville (UAH), that would provide additional flight research opportunities on the Space Shuttle for NASA's 17 Centers for the Commercial Development of Space (CCDS). In support of this, Instrumentation Technology Associates, Inc., Exton, Pennsylvania, signed a commercial agreement with UAH to provide the university's Consortium for Materials Development in Space CCDS, with flight hardware that would be flown on five Shuttle missions. (NASA Release 91-203)

December 12: Paul Hays, scientist in charge for NASA of one of 10 instruments on the Upper Atmosphere Research Satellite (UARS), launched by Discovery on September 15, said the UARS discovered surprisingly violent, continent-size 200-mile-per-hour windstorms in a rarely studied part of the atmosphere known as the mesosphere. (AP, Dec 12/91; *C Trin*, Dec 13/91; *P Inq*, Dec 14/91; *W Post*, Dec 16/91; *LA Times*, Dec 16/91; *NY Times*, Dec 17/91)

- The Aerospace Industries Association said on December 11 that the U.S. aerospace industry would post record sales of \$140 billion in 1991, but that employment during the year dropped eight percent to 1.16 million workers. (*LA Times*, Dec 12/91)

- Joseph Stickle, chief engineer at NASA's Langley Research Center, was quoted in connection with NASA's role in promoting small planes. He said

that the annual convention of the Experimental Aircraft Association, held in Oshkosh, Wisconsin, was a place where NASA featured its innovations that would make small planes safer, such as a spin-resistant design, lightning-protection technology, or airfoils. (*WSJ*, Dec 12/91)

December 13: The media covered the refusal of a Federal judge on December 12 to order the public release of the audio tape of the last moments of the seven astronauts who died aboard the Space Shuttle Challenger in 1986, saying it would violate the privacy of the victims' families. (*NY Times*, Dec 13/91; *W Post*, Dec 13/91; *USA Today*, Dec 13/91; *W Times*, Dec 13/91; AP, Dec 13/91)

- William B. Lenoir, Associate Administrator for Space Flight, said NASA hoped to cut the operating cost of its Space Shuttle program by 15 percent over a five-year period. It planned to do this by eliminating a layer of management and merging the offices of the Program Directorate in Washington, Level I, with the Program Office located at the Lyndon B. Johnson Space Center in Houston, Level II. The reorganization plan as yet lacked final approval. (*W Times*, Dec 13/91; *Fla Today*, Dec 13/91)

- NASA announced the development by its Jet Propulsion Laboratory, Pasadena, of a new, more accurate, airborne radar system for topographic mapping of the Earth's surface. The instrument, called TOPSAR for topographic synthetic aperture radar, would be about three times more accurate than existing topographic mappers and had many commercial and scientific uses, according to Howard Zebker of the Pasadena laboratory. (NASA Release 91-205)

- NASA announced that researchers at its Langley Research Center, Hampton, Virginia, had developed a laser-based system for measuring winds above launch sites. The system called CLAWS, for Coherent Launch Site Atmospheric Wind Sounder, was created by the Spacecraft Controls Branch, Flight Systems Directorate, and Lockheed. CLAWS was used in the September 12 launch of Space Shuttle Discovery and might eventually replace weather balloons as a means of gathering data aloft. (NASA Release 91-206)

December 14: The *Cleveland Plain Dealer* reported that NASA's Lewis Research Center on December 13 refused to sign cleanup orders for nine sites within the Brook Park complex that were contaminated with hazardous materials. NASA officials indicated they wished to continue talks with the Ohio Environmental Protection Agency and that signing the orders would mean waiving their right to appeal. Moreover, they complained the agreement did not limit the sum the Ohio EPA could charge for overseeing the cleanup. (*Cleveland Plain Dealer*, Dec 14/91)

December 15: The *Chicago Tribune* carried an article dealing with the boon that the blurred vision of the Hubble Space Telescope was proving to

researchers. Some dozen teams of scientists took Hubble data and using their computer enhancement programs produced clearer images. In the process they have raised their own profiles in a sometimes obscure research field. (C Trin, Dec 15/91)

- According to the *Washington Post*, for the fourth time since April, NASA scientists at the Jet Propulsion Laboratory in Pasadena were trying to free the antenna on the robot explorer Galileo. The scientists deduced that three of the 18 ribs of the antenna were stuck in the closed position. Being unable to deliver direct force, they sought to “shake” the structure by alternately heating and cooling it. On December 14-15, NASA tried again to free the jammed antenna without success. (*W Post*, Dec 15/91; UPI, Dec 16/91; *W Post*, Dec 17/91; *W Post*, Dec 18/91; *USA Today*, Dec 18/91)

December 16: NASA announced the Extreme Ultraviolet Explorer (EUVE) satellite was scheduled to be launched from Cape Canaveral Air Force Station, Florida, on May 28, 1992. The delay in the originally scheduled launch time was caused by the need for Modular Antenna Pointing System acceptance testing, which was completed, and software/hardware verification, which remained to be completed. (NASA Release 91-207)

- NASA announced the appointment of Leonard S. Nicholson as director, Space Shuttle program, replacing Robert L. Crippen who is to be director, Kennedy Space Center, Florida. (NASA Release 91-208; AP, Dec 16/91; *W Times*, Dec 17/91; *USA Today*, Dec 17/91; *Fla Today*, Dec 17/91; *W Post*, Dec 18/91)

December 17: The *Wall Street Journal* discussed the January 1989 offer by Nikolai Ponomarev-Stepnoy, leader of a Soviet design team that built a top secret military spy satellite, the Topaz-2, to sell, for a few million dollars, the Topaz-2 with the satellite’s lightweight nuclear reactor. Moscow had no money to develop the reactor for commercial use but the paper deplored the U.S. delay in taking up the offer. The above discussion followed up on a statement by the Pentagon’s Strategic Defense Initiative Office, reported on December 11, that the office stopped its share of funding for a space-based nuclear reactor projected to cost \$1.6 billion by 2002. The reactor program, called SP-100, was shared by NASA and the Department of Energy. Instead the Pentagon office was inclined to go with the Soviet-style process represented by the Topaz, for which it earmarked \$15 million. (*WSJ*, Dec 11/91; *WSJ*, Dec 17/91)

- NASA released a lengthy report summarizing its 1991 activities. In addition to the various space flights and satellites deployed, the report covered the following fields: NASA management; space science and applications, with specific reference to Mission to Planet Earth, astrophysics, life sciences, solar system exploration, space physics, and ground-based research; space flight,

including the Space Shuttle and flight systems; space systems development, stressing Space Station Freedom; exploration; aeronautics and space technology, including the X-30 National Aerospace Plane; commercial programs, covering the commercial use of space, technology utilization, and small business innovation research; international relations; space communications; education; safety and mission quality; and FY 1992 NASA appropriations. (NASA Release 91-209)

December 19: Stephanie E. Meyers, Director of the Office of Commercial Space Transportation in the Office of Transportation, set forth the role of her office and the goals for commercial space. She saw the goals as the creation of space and ground systems essential to space operations in low Earth orbit. These ground systems needed to be adequate to support launches. Second, there must be government-owned and privately-owned launch vehicles to carry freight and passengers to the Space Station. In addition, commercial space companies faced obstacles in pursuing business in this very competitive industry and fair-trade relationships needed to be established. (*Washington Technology*, Dec 19/91)

December 19: NASA's Goddard Space Flight Center/Wallops Flight Facility, Wallops Island, Virginia, announced a contract award to H&H Consolidated, Inc., of Hampton, Virginia for operation/maintenance and alteration/modification of facilities and equipment services. (NASA Release C91-ss)

- The *Christian Science Monitor* reviewed NASA's nine proposed Space Shuttle missions for 1992. It noted the strong international flavor of the missions, including the ascent of the first Italian Space Agency astronaut aboard Atlantis in July 1992. Astronauts from Canada and the European Space Agency were to fly on several missions. In August, Japan's first professional astronaut was to ride on the new orbiter Endeavour, scheduled to debut in May as replacement for the Challenger. Other proposed missions and their scheduled dates were outlined. (CSM, Dec 19/91)

- The *New York Times* reported that Edward C. Aldridge, Jr., president of McDonnell Douglas Electronic Systems, who served on the National Space Council that made recommendations on NASA's programs, was to become president and chief executive of Aerospace, a federally financed research and development center in El Segundo, California. (*NY Times*, Dec 19/91)

- The media stated that Space Shuttle Discovery was rolled to the launch pad to prepare for its scientific research mission in late January 1992. (AP, Dec 19/91; *W Times*, Dec 20/91; *USA Today*, Dec 20/91; *LA Times*, Dec 20/91)

December 20: NASA announced the selection of 70 research proposals for negotiation of Phase II contracts in NASA's Small Business Innovation Research Program. The high technology firms were located in 21 states. (NASA Release 91-210)

December 22: An article critical of NASA for emphasizing space at the expense of the domestic aviation industry appeared in the *Los Angeles Times*. An example cited was Boeing's need to use a wind tunnel research facility operated by the Royal Aerospace Establishment in Britain to test its new top-secret 777 passenger jet because NASA had shut its decrepit wind tunnel in Sunnyvale, south of San Francisco. The aeronautics community reportedly felt neglected because only 6 percent of NASA's budget was allocated to aeronautics. As a result, there was little government support for research and development in U.S. general aviation, which has suffered in relation to government support given by other countries to their aviation industries. (*LA Times*, Dec 22/91)

- According to the *Los Angeles Times*, the Soviet space program was facing a difficult future. The main elements of the Soviet space program were concentrated in three republics: Russia, Ukraine, and Kazakhstan. Rockets were built primarily in Ukraine, control centers and instrument manufacturing plants were mainly in Russia, and the principal launch facility, the Baikonur Cosmodrome, was in Kazakhstan. Marcia S. Smith, the Soviet space expert on the staff of the Congressional Research Service, said those three republics agreed in early October they could operate by themselves. However, the economic situation became worse, causing increasing criticism. Nevertheless, communications satellites were essential to produce foreign investments and maintain a link with the outside world. Space research had technological spinoffs in areas such as computers, transportation, communications, and propulsion. Therefore, U.S. experts did not believe the former Soviet states would allow the space program to die. (*LA Times*, Dec 22/91)

December 23: James C. Fletcher, who twice served as NASA Administrator (April 1971 - May 1977, May 1986 - April 1989), died of cancer. (*AP*, Dec 23/91; *W Post*, Dec 24/91; *NY Times*, Dec 24/91; *W Times*, Dec 24/91)

- The General Accounting Office (GAO) report on NASA indicated it needed to improve contract oversight to reduce cost overruns and schedule delays. According to the GAO, one in every three NASA contracts experienced cost overruns and two in five experienced delays. The conclusion was based on audits at Marshall, Kennedy, Goddard, and Johnson field centers based on a statistical sample of 317 active or administratively closed-out contracts between 1984 and 1989. (*Htsavl Tms*, Dec 23/91)

- NASA announced details of Space Shuttle mission STS-42, a worldwide research effort in the behavior of materials and life in weightlessness. This would be the 15th flight of Discovery and was scheduled for launch on January 22, 1992 from Edwards Air Force Base, California. Scientists from NASA, the European Space Agency, the Canadian Space Agency, the French National Center for Space Studies, the German Space Agency, and the National Space Development Agency of Japan cooperated in planning experiments aboard the International Microgravity Laboratory-1, which Discovery was to carry. This was to be the first of eight Space Shuttle flights planned for 1992, five of which were to feature international participation. (NASA Release 92-211)

December 24: In an article on the Antarctic, Robert Bindschadler, a NASA glaciologist, was quoted as pointing to his photos that marked two huge streams, 30 miles wide, of solid ice. He planned to drive stakes into the ice along a 90-mile line just below the mouth, and return two years later to see how far the stakes moved. By comparing the outflow of ice with measurements of snow accumulation in the interior, scientists can calculate whether the ice sheet is shedding ice. (WSJ, Dec 24/91)

- The *New York Times* printed a feature article concerning the effects of El Niño and of the volcanic eruption of Mount Pinatubo on global climate. Reportedly, most climatologists agreed that the tiny drops of sulfuric acid and water produced by Mount Pinatubo's gaseous cloud would exert a cooling effect on the planet. NASA's James E. Hansen, of the Goddard Institute of Space Studies in New York, attempted to calculate the magnitude of this cooling. Based on a computerized simulation of the global climate, he placed the expected cooling at about 1 degree Fahrenheit—about enough to cancel out, temporarily, the global warming that occurred over the last 100 years. (NY Times, Dec 24/91)

December 25: Ivan Bekey, a NASA space power expert, was quoted by the *New York Times* in connection with an article on solar power from space. Bekey said that power beaming was not a problem. Rather, the difficulty was getting a large enough satellite into orbit. Currently large satellites ran between 20,000 to 30,000 pounds whereas a satellite to enable developing solar power would need to be some 100 times larger than that. Another possibility would be to mine the silicon for the solar cells and the aluminum for the structure from the moon. Those materials might make up 90 percent of the mass, meaning less weight would need to be launched from Earth. Bekey foresaw that developing power from space would be 20 or 30 years away. (NY Times, Dec 25/91)

December 26: The U.S. Space Surveillance Network, inside Cheyenne Mountain, Colorado, originally designed to serve as an early warning system

against missile attacks, was described. The organization now mainly is engaged in tracking 7,000 pieces of orbiting space debris, to which some 240 new pieces were added each year. Efforts were being made internationally to develop new technologies to track space debris. In all, more than 100 spacecraft fragmented while in orbit, including at least 12 satellites deliberately destroyed by the United States and the Soviet Union during weapons testing. (*P Inq*, Dec 26/91)

December 27: The *Los Angeles Times* indicated that various scientific teams from the United States, Japan, and Europe, were trying to develop solar-sail spacecraft to race to the moon. At the time of writing, the Russian Federation was ahead of the other teams and planned to launch a test craft in October 1992. None of the research teams was government-sponsored and financing was a problem. Theoretically, the sail craft were to be propelled through space by tiny solar particles called photons. (*LA Times*, Dec 27/91)

December 28: UPI reported that although the Soviet Union no longer existed officially, the Soviet Space exhibit in Fort Worth, Texas, had not changed its name, nor would this happen when the space show move to St. Louis in early January. The exhibit proved very popular and attendance was up 60 percent; no official figures were given. (UPI, Dec 28/91)

- According to AP, Ron Williams, who was chief pilot in a five-month research project sponsored by NASA to determine whether the Arctic had the same kind of ozone hole detected over the Antarctic five years previously, was about to fly his ER-2 plane from Bangor, Maine, with a ton of scientific instruments aboard. (AP, Dec 28/91; *W Times*, Dec 29/91)

December 31: The *Philadelphia Inquirer* described the Temple University Hospital study on behalf of NASA to determine whether amino acid supplements could retard muscle loss. If so, astronauts on long space flights might not need to devote so many hours to exercise. Eighteen volunteers were being cycled through the six-day bed rest program, in groups of three. (*P Inq*, Dec 31/91)

January

January 2: NASA announced that on January 6, 1992, Administrator Richard H. Truly will officially present the NASA 1991 George M. Low Trophy to Thiokol Corporation, Space Operations employees, Brigham City, Utah. The trophy recognizes NASA prime contractors, subcontractors, and suppliers for outstanding achievements in quality and productivity improvement and Total Quality Management (TQM). Thiokol's Space Operations provides the redesigned solid rocket motor propulsion that produces 80 percent of the thrust necessary for Space Shuttle liftoff. In addition, Thiokol provides engineering services for sounding rocket design for NASA's Goddard Space Flight Center, Greenbelt, MD. (NASA Note N92-1)

January 6: Following a routine star calibration, the Magellan spacecraft, which had completed 15 months of service and 3,880 orbits of successfully mapping over 95 percent of the surface of Venus, appeared to have suffered a component failure in one of its two downlink transmitters, temporarily halting the reception of mapping data with its high-resolution radar. (NASA Release 92-1)

January 7: NASA announced that the first flight of the IML-O1 (International Microgravity Laboratory), was set for January 22, 1992, aboard the Space Shuttle Discovery. Over 220 scientists from 14 countries were to be represented in this unprecedented international effort to conduct research in both materials and life sciences in the microgravity environment. (NASA Note N92-3)

January 9: Many scientists, concerned that there might not be enough money for basic research, question the wisdom of spending huge sums on projects such as the Space Station. Yet, research shows that the economic benefits of NASA's programs are greater than generally recognized. In 1987, NASA's procurement budget generated \$17,800 million in total industry sales, had a "multiplier effect" on the economy of 2.1 million people, created 209,000 private-sector jobs and \$2,900 million in business profits, and generated \$5,600 million in Federal, State and local government tax revenues. Furthermore, these benefits were widely distributed throughout the country. (*Nature*, Jan 9/92)

January 13: At the American Astronomical Society's semiannual meeting in Atlanta, a team of scientists announced that, using NASA's Hubble Space Telescope (HST), they had made the most precise measurement to date of the percent of heavy hydrogen in space, which better determines the physical conditions present in the theorized Big Bang at the origin of the universe. Deuterium, also called heavy hydrogen, differs from ordinary hydrogen by having one neutron in addition to one proton in its nucleus. A measurement of the ratio of deuterium to ordinary hydrogen provides a critical test of con-

ditions in the universe at the time of the Big Bang because it is believed that essentially all of the deuterium now present was created at that time. If further research finds no evidence for large amounts of "missing matter," then the new deuterium measurements strengthen the idea that the universe will expand forever. If true, the universe had a brilliant beginning but will have no end. (NASA Release 92-2)

- Astronomers reported interesting initial results from a survey of several hundred quasars being studied with NASA's Hubble Space Telescope (HST). Using Hubble's high resolution images, the "Snapshot Survey" program detected evidence on gravitational lensing at a level of detail not usually found with ground-based telescopes. The findings set new limits on the nature and distribution of material in the universe. The results provided information on objects such as stars and galaxies that can be detected with telescopes as well as non-luminous material or "dark matter." In the past decade, about a dozen examples of probable gravitational lenses had been discovered by ground-based telescopes. According to conventional theoretical models, approximately half of all multiple-image gravitational lenses cannot be identified from ground-based telescopes because the separation between the images would be less than one arc second, which is below the nominal resolution limit for ground-based telescopes. The Hubble Space Telescope routinely provides 0.1 arc second resolution of moderately bright point sources, making it a unique and powerful tool for searching for multiple-image lenses. The HST data may ultimately provide new and unexpected insights into the early universe. While the Snapshot Survey will not offer insights into the competing Big Bang models, results will provide scientists with the denizens of the universe but not how they got there. (NASA Release 92-3)

- At a press conference of the 179th meeting of the American Astronomical Society in Atlanta, astronomers reported that recent ultraviolet observations with NASA's Hubble Space Telescope (HST) suggest that what were thought to be randomly distributed, nearby primordial clouds of hydrogen may actually be associated with galaxies or clusters of galaxies. (NASA Release 92-4)

- Using NASA's Hubble Space Telescope (HST), astronomers announced the detection of the rare element boron in an ancient star. This element may be "fossil" evidence of energetic events which accompanied the birth of the Milky Way galaxy. An alternative possibility is that this rare element may be even older, dating from the birth of the universe. If that is the case, then the HST findings may force some modifications in theories of the Big Bang. (NASA Release 92-5)

January 14: Dr. Carl Fichtel, principal investigator for the Energetic Gamma Ray Experiment Telescope (EGRET), announced that NASA's Compton Gamma Ray Observatory found three new gamma-ray quasars, detected more than 200 cosmic gamma ray bursts, and captured the best ever observation of

the glow of gamma radiation from the disk of the Milky Way galaxy. The Compton Observatory, built by TRW Inc., Redondo Beach, California, is the second of NASA's "Great Observatories." The first was the Hubble Space Telescope, launched in April 1990. The Compton Observatory, deployed April 7, 1991, from the Space Shuttle Atlantis, orbits Earth at an altitude of 268 by 262 miles. (NASA Release 92-6)

January 15: NASA's Assistant Administrator for Procurement Darleen A. Druyun lifted the suspension of the Collins Avionics and Communications Division (CACD), Rockwell International Corp., Cedar Rapids, Iowa. The suspension was imposed November 8, 1991, following a 15-count indictment charging the firm and two individuals with mail fraud and submission of false claims. (NASA Release 92-7)

- Project officials at NASA's Jet Propulsion Laboratory, Pasadena, California, announced that the Magellan spacecraft would use its backup transmitter to resume mapping the surface of Venus with imaging radar on January 24, following a week of routine battery recharging. (NASA Release 92-8)

January 16: Using NASA's Hubble Space Telescope (HST), Dr. Jon Holtzman, of Lowell Observatory, Flagstaff, Arizona, led a team of scientists in discovering new clues to cataclysmic events in the history of the peculiar galaxy NGC 1275, located approximately 200 million light-years from Earth. The scientists discovered about 50 bright objects at the center of the galaxy which appear to be young massive globular star clusters. This discovery was surprising because most globular clusters are among the oldest objects in the universe. (NASA Release 92-9)

- Based upon images taken by NASA's Hubble Space Telescope (HST), astronomers reported that they had found intriguing evidence that a black hole, weighing over 2.6 billion times the mass of the Sun, exists at the center of the giant elliptical galaxy M87. Galaxy M87 is at the center of a nearby cluster of galaxies in the constellation of Virgo, 52 million light-years distant, and contains more than 100 billion stars. (NASA Release 92-10)

January 17: NASA Administrator Richard H. Truly met with representatives from seven Historical Black Colleges and Universities (HBCUs), the latest recipients of NASA's Research Center grants. The awards were the latest approach to meeting some of NASA's present and future research and workforce needs and in tapping into scientific resources found among under-represented minority students and faculty at qualifying universities. (NASA Release 92-11)

January 22: Amid concerns over cold weather, the Shuttle Discovery was prepared for launch from Cape Canaveral at 8:53 a.m. EDT. (*USA Today*, Jan 22/92)

- The flight of Space Shuttle Discovery, carrying seven astronauts from three countries, was the second Shuttle mission in a row to carry an array of life science experiments focusing on the effects of space travel on humans and other organisms, with an eye toward preparing to send astronauts on interplanetary flights, specifically, NASA's proposed manned mission to Mars. The astronauts split 12-hour work shifts so experiments including a battery of medical tests could be conducted non-stop. Researchers hoped to learn more about space motion sickness and back pain, common ailments among astronauts in orbit. Experiments were also to be conducted in the cargo bay to measure effects of zero gravity, fertilization of eggs, and cartilage formation in various organisms. The Shuttle would also study the effect of bombardment by high-energy cosmic rays on living tissue. (*B Sun*, Jan 22/92; *NY Times*, Jan 23/92)

- J.P. Mitchell, Pratt & Whitney's Space Shuttle Main Engine (SSME) Alternate Turbopump Development project manager, reported that a pair of Pratt & Whitney designed high-pressure turbopumps had been tested successfully at 100 percent rated power on a SSME at NASA's John C. Stennis Space Center in Mississippi. (*PR Newswire*, Jan 23/92)

January 24: President Bush held a scheduled meeting with NASA astronauts in the Oval Office, followed by an address to Young Astronauts Council in the Old Executive Office Building. (NASA Release 92-12)

- White House administration officials reported that President Bush had called for an 11 percent increase in the Space Station project for 1993, as well as additional money to put robots on the Moon and build a new space launch system and a hypersonic transport plane. The Space Station project, which aims to launch a permanent orbiting platform by 1996, was slated for \$2.25 billion. Bush also requested \$8 million to develop a NASA plane that could make direct flights from Earth to orbit without using the traditional rocket booster launch system. If successful, it would revolutionize air travel by flying around the world in a fraction of time compared to conventional aircraft. (*NY Times*, Jan 25/92; *P Inq*, Jan 25/92; *WSJ*, Jan 27/92)

- Arthur C. Clarke, the legendary science-fiction writer, whose accomplishments include numerous literary awards, academic honors, and more than 70 written works, including "2001: A Space Odyssey," declared that his latest personal odyssey was contemplating the feasibility of "colonizing" and "farming" on Mars. "Mars is the next frontier, what the Wild West was, what America was 500 years ago...Mars is where the action is going to be in the next thousand years," declared Clarke. (*LA Times*, Jan 24/92)

- On the second day of Discovery's mission, astronauts took turns being spun in a chair, strapped blindfolded onto a lurching sled, and jolted by electrodes high above the Earth in a study of space motion sickness. Between medical

tests, the seven astronauts tended to organisms carried into orbit for research, including roundworms, fruit flies, stick insects, lentil roots, bacteria, and billions of single cells. The mission was scheduled to end at Edwards Air Force Base in California. (*NY Times*, Jan 24/92)

- President Bush kicked-off International Space Year (ISY), a year-long worldwide celebration of space cooperation and discovery. During the year, 29 space agencies and ministries from around the world, 10 international organizations, and the United Nations planned to celebrate the spirit of discovery and work together to promote a new era of global cooperation and to increase knowledge of planet Earth. (NASA Release 92-13)

January 25: David H. Suddeth, 63, a NASA engineer who was honored by the Agency for his work on propulsion systems for spacecraft, died in Bowie, Maryland. His research included work on hydrazine-fueled rocket engines used to guide satellites and the Viking spacecraft, which landed on Mars in 1976. He was with NASA's Goddard Space Flight Center from its inception in the late 1950s until he retired in 1990. (*W Post*, Jan 30/92)

- L. Eugene Root, a pioneer U.S. aircraft builder who led Lockheed Missile and Space Company to maturity and was a member of the Rand think tank, died in Menlo Park, California, at the age of 87. As president of the Institute of Aeronautical Sciences in 1962, Root combined his organization with the American Rocket Society, co-founding the major U.S. aerospace society, the American Institute of Aeronautics and Astronautics. (*LA Times*, Jan 25/92)

January 26: Discovery's astronauts dimmed the Shuttle lights to conserve energy as NASA considered extending the weeklong research mission by a day to collect extra scientific data. (*P Inq*, Jan 27/92; *W Times*, Jan 27/92)

January 27: The main Russian TV news reported that some members of the former Soviet Union's cosmonaut ground controllers planned a warning strike to protest low wages, which in many cases were equivalent to \$6 a month. The television report said that "One of the most prestigious jobs on Earth had become one of the lowest-paid." (*W Times*, Jan 28/92; *P Inq*, 28/92)

- William R. Schindler, 64, a former project manager of the Delta launch vehicle project at NASA's Goddard Space Flight Center, died in Loma Linda, California. (*W Post*, Jan 29/92)

January 28: In an article in the January 16 issue of the journal *Nature*, Dr. Chris Argyrou Hajivassiliou of the Mullard Radio Astronomy Observatory in Cambridge, England, proved through statistical analysis that the scattering of radio waves caused by turbulent interstellar electrically charged gases, or plas-

ma, is present in areas of the galaxy where it had not been previously proven to exist. The findings are considered evidence that the solar system is encapsulated in an envelope of these gases, probably the relic of the explosion of a nearby massive star tens of millions of years ago. In his article, Dr. Hajivassiliou said that he hoped scientists would be able to use his findings to identify any black hole left by that explosion. (*NY Times*, Jan 28/92)

- George C. Patterson Jr., 67, a retired NASA official who worked for the Agency for 30 years before retiring in 1987 as a flight mission simulation coordinator, died of emphysema January 26 at Holy Cross Hospital, Kensington, Maryland. (*W Post*, Jan 28/92)

- Scientists from University of Washington in Seattle, writing in *Science* magazine, said that the sulfuric haze that causes acid rain might also be protecting the Northern Hemisphere by countering the warming brought on by the greenhouse effect. (*P Inq*, Jan 28/92)

- As part of the 1993 budget, President Bush approved the cancellation of two major NASA projects—a scientific mission to rendezvous with an asteroid and a program to build more powerful Space Shuttle boosters. Under the budget plan, the White House cancelled the Advanced Solid Rocket Motor (ASRM), a \$3 billion program to develop new and more powerful boosters for the Space Shuttle, as well as the Comet Rendezvous Asteroid Flyby mission, a \$700 million spacecraft slated for launch in the late 1990s. The 1993 Bush plan allocated a \$700 million increase over the 1992 \$14.3 billion NASA budget. (*Space News*, Jan 28/92)

- Final preparations were made for the launching of Earthwinds, a balloon whose three-member crew hoped to be the first to circumnavigate the world in a single balloon flight. Larry Newman, the captain of the Earthwinds and a former crew member of both the transatlantic balloon flight in 1978 and the transpacific flight in 1981, predicted a successful voyage of some 22,000 miles at an altitude of about 35,000 feet. Included in the crew, was to be Maj. Gen. Vladimir Dzhaniybekov, chief of astronaut training in the Russian air force. The balloon, which is higher than the Statue of Liberty, would carry scientific experiments built in the former Soviet Union and NASA. (*NY Times*, Jan 29/92)

January 29: Jim Scott, Magellan project manager at the NASA's Jet Propulsion Laboratory, expressed regret at NASA's decision to cut short the spacecraft's mission. Since its launching from the Space Shuttle Atlantis on May 4, 1989, the spacecraft had mapped 97 percent of Venus' surface, using radar to peer through the planet's thick clouds and take pictures of the rugged, volcanic landscape. Scientists hoped to continue mapping in more detail during an "extended mission" ending in 1995, but NASA officials decided to

avoid adding \$80 million to the cost by ending the mission on September 30, 1993. The budget decision meant that engineers would not be able to move Magellan from its elliptical orbit and into a lower circular orbit starting in May 1993. That would have allowed Magellan to remap Venus with three to 10 times more detail than the pictures it already had taken. (NASA Release, 92-14; *W Times*, Jan 29/92)

- The Space Shuttle Discovery's international crew took time off from their scientific work to remember the seven astronauts who died in the explosion of the Shuttle Challenger six years ago. "It being the 28th, we're all mindful of the sacrifices made along the way," Discovery crewman William Readdy said during a news conference from space. It was the first time that Americans had been in orbit on the anniversary of the January 28, 1986 explosion of Challenger 73 seconds after it took off from Cape Canaveral. (*P Inq*, Jan 29/92; *USA Today*, Jan 29/92)

- With the dissolution of the Soviet Union, the fate of the Russian space program is in doubt. Although most of the republics that make up the successor to the Soviet Union, the Commonwealth of Independent States, had signed an agreement pledging to continue the space program and to honor all the Soviet Union's international agreements on space projects, many experts questioned the impoverished nascent union's ability to follow through. "There is a high level of uncertainty," said James Head, a planetary scientist at Brown University. "The commonwealth will absolutely not be able to maintain a space program at the same level of activity," declared Roald Sagdeev, former director of the Soviet institute that ran all scientific research programs in space. (*C Trib*, Jan 29/92; *Boston Globe*, Jan 30/92)

February

February 1: NASA's plan to transfer work modifying Space Shuttles from Palmdale to its Kennedy Space Center in Florida triggered protests from California's congressional delegation and the governor's office. The NASA decision would affect about 500 jobs at Rockwell International's Palmdale facility, where five of the orbiters had been assembled since the 1970s and where the space agency had done major modification work on the Shuttle fleet. (*LA Times*, Feb 1/92)

February 2: *Florida Today* reported that the Hubble Space Telescope, despite a flawed primary mirror that prevented it from stargazing perfectly, nevertheless had shown astronomers enough of the universe to rattle their theories of creation and the nature of the universe. Circling the Earth every 90 minutes, the Hubble has provided new insights into "globular clusters, the black hole, gaseous hydrogen isotopes, and a shell of gas moving from a giant star in another galaxy." (*Florida Today*, Feb 2/92)

February 3: According to some scientists, recent observations by NASA's Upper Atmosphere Research Satellite (UARS) have shown exceptionally high levels of chlorine monoxide (ClO) at high northern latitudes, raising the possibility of enhanced ozone depletion over populated areas of the Earth. UARS's Microwave Limb Sounder (MLS) detected elevated levels of ClO over large areas of Europe and Asia north of about 50 degrees latitude. Dr. Joe Waters of NASA's Jet Propulsion Laboratory said that high ClO levels were observed over Scandinavia and Northern Eurasia, including the cities of London, Moscow, and Amsterdam. These ClO levels, approximately one part billion by volume, are comparable to levels observed within the Antarctic ozone hole. Waters said that sustained levels of ClO could lead to significant ozone destruction over the northern hemisphere and perhaps even lead to an ozone hole over the Arctic. (NASA Release 92-18)

- It was reported that NASA's decision to kill off a multibillion-dollar program to develop a new, more powerful solid rocket booster for the Space Shuttle fleet was a carefully planned move actually intended to help save the project. The advanced solid-rocket motor program, which would have cost nearly \$500 million in 1993, was eliminated with the expectation that funds for the project would be restored by Representative Jamie L. Whitten (D-Miss.), chairman of the House Appropriations Committee. (*LA Times*, Feb 3/92)

February 4: Many scientists believe that by using "telepresence," a unique mix of science and engineering that NASA was developing, astronauts may someday explore Mars without leaving their base camp. Dr. Geoffrey Briggs of NASA's Ames Research Center, Mountain View, California, said "telepres-

ence will allow humans to project themselves, by way of a suitably equipped robot, into a remote environment without endangering themselves." Telepresence, which is similar to "virtual reality," will allow a researcher, wearing a video headset, to see remote locations through cameras mounted on a remotely operated robotic vehicle. The researcher points the camera by moving his or her head and steers the vehicle with a pair of joysticks or with body motion. Manipulators on the robot relay the "feel" of an object's weight and texture. Briggs called the research technique "revolutionary" because it made it possible to simulate planetary studies in hostile earthly environments, such as the frigid waters of Antarctica, and eventually to perform real research on the Moon and Mars. (NASA Release 92-20)

- NASA, in conjunction with the Nation's two leading aircraft engine makers, reported that it would be developing advanced materials that could make a next-generation supersonic airliner possible by the year 2005. A five year, \$88 million partnership with General Electric Aircraft Engines, Cincinnati, and United Technologies, Pratt & Whitney Division, East Hartford, Connecticut, was to center on critical composite materials and processes that U.S. industry would need to design and build a fleet of high-speed civil transports. The planes would fly at more than twice the speed of sound and at much higher altitudes than today's commercial airliners. A cost-effective, environmentally compatible supersonic airliner could cut long-distance trip times in half. For example, a future high-speed civil transport could fly from Los Angeles to Tokyo in 4 1/2 hours instead of the 10 hours taken by present subsonic passenger planes. While NASA, Pratt & Whitney, and General Electric will form the core of the team, many other U.S. engine companies, materials suppliers, and composite fabricators also will play an integral part. This interaction will provide the base for a future U.S. manufacturing capability in high-temperature composites and will let the involved firms take early advantage of the program's technical results. The composites also will help American manufacturers of subsonic airplanes, power systems, and military aircraft. (NASA Release 92-21)

- NASA issued its strongest warning yet about the quickening deterioration of the ozone layer over large, populated areas in northern latitudes. Experts warned that thinning ozone will let in more harmful ultraviolet rays from the Sun and lead to more skin cancer and cancer deaths. An ozone layer hole could appear as early March 1992 if certain meteorological and chemical conditions occur, said the scientists. Even if the hole does not appear right away, the chances are "very high" that it will occur over the next decade, said James Anderson, a Harvard University chemistry professor who is involved in the project. (WSJ, Feb 4/92; *P Inq*, Feb 4/92; *NY Times*, Feb 4/92; *USA Today*, Feb 4/92; *W Post*, Feb 4/92; *W Times*, Feb 4/92; *LA Times*, Feb 4/92; *B Sun*, Feb 4/92)

- Dr. Mark M. Phillips, acting director of Cerro Tololo, an American operated observatory in Chile, said the New Technology Telescope developed in

Europe was capturing images up to six times more revealing than those obtained by comparable American telescopes of conventional design. The new European telescope contained advanced optical elements that automatically correct the distortions caused by gravity and wind as the telescope moves. There was an uneasy feeling among some scientists that the salad days of United States astronomy were drawing to a close and that the new European telescopes would leave American astronomers far behind. (*NY Times*, Feb 4/92)

February 5: Explorers reported that the lost city of Ubar, called "the Atlantis of the Sands" by Lawrence of Arabia, had been found in Oman using pictures taken from the Space Shuttle Challenger in October 1984. The city was thought to have been inhabited from 2800 B.C. until A.D. 100. (*USA Today*, Feb 5/92; *W Times*, Feb 5/92; *P Inq*, Feb 5/92; *NY Times International*, Feb 5/92; *B Sun*, Feb 5/92)

- Thomson Consumer Electronics, owned by the French electronics concern Thomson SA, said that it would help launch a satellite-to-home television broadcasting system through a venture with the Hughes Electronics division of General Motors Corporation. The system, called DirecTV, would be capable of providing more than 100 channels to 18-in-diameter outdoor satellite dishes. (*B Sun*, Feb 5/92)

February 7: A panel of experts at a meeting of the American Association for the Advancement of Science said that computers now perform some medical functions better than doctors and that machines are going to get even smarter in the future. Terrell Ward Bynum of Southern Connecticut State University said that NASA and the Department of Defense were working on a "smart" battlefield stretcher, which as envisioned, could provide expert diagnostic capabilities and would be able to dispense drugs or even jolt the heart back into normal rhythm. (*AP*, Feb 7/92)

February 10: Space Shuttle Mission STS-45 was designated for the first flight of the Atmospheric Laboratory for Applications and Science (ATLAS-1). The ATLAS-1 was to measure long-term variability in the total energy radiated by the Sun and measure the Earth's middle atmospheric constituents over one 11-year solar cycle. (NASA Note N92-14)

- It was reported that the Hubble Space Telescope (HST) was studying aurorae on the giant planet Jupiter. The HST made observations of Jupiter over a four-day period when ESA/NASA Ulysses spacecraft swung by the giant planet. While passing Jupiter, Ulysses made measurements of Jupiter's powerful magnetic field and the flow of subatomic particles along magnetic field lines. Simultaneously, HST was looking at aurorae, one visual manifestation of these electrical fireworks. These joint observations provided a unique oppor-

tunity to combine ultraviolet images and spectra with information on particles and fields. By studying the activity of Jupiter's aurorae, astronomers hoped to learn more about the dynamics of Jupiter's immense magnetic field, the structure of the giant planet's upper atmosphere, the effects of aurora on the chemistry of the polar regions on Jupiter, and Jupiter's interaction with the Moon Io via a magnetic "flux tube." (NASA Release 92-22)

- Reinhard Genzel of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, declared that there was mounting evidence that a black hole about a million times the mass of the Sun is sucking away at the heart of the Milky Way, Earth's home galaxy. The latest clue was a bubble of gas possibly as hot as a million degrees centigrade discovered near a mysterious source of radio waves known as Sagittarius A, which had for some time been the leading candidate for the location of the suspected black hole. (*W Post*, Feb 10/92; *P Inq*, Feb 6/92; *USA Today*, Feb 6/92)

February 11: It was reported that NASA's latest effort to free a stuck main antenna aboard the Galileo space probe had failed. Galileo, en route to Jupiter for a 1995-97 mapping mission, had a smaller antenna that transmitted only 2,200 of the 50,000 hoped-for photos. (*W Times*, Feb 11/92; AP, Feb 10/92; *USA Today*, Feb 11/92)

- A 15-story unmanned Atlas rocket was launched into space with a military communications satellite intended to link the White House with U.S. forces around the world during nuclear attacks or other crisis. In peacetime, the \$130 million satellite was to serve as a switchboard for the Defense Department personnel. (*B Sun*, Feb 11/92; AP, Feb 11/92)

February 12: NASA research aircraft were exploring the potential of fiber optic sensors in critical aircraft flight control systems. Because of fiber optic's advantages in flight systems, researchers believe fiber optics will improve flight control, engine performance, and safety. The research project is part of the Fiber Optic Control System Integration program managed by NASA's Lewis Research Center, Cleveland and jointly funded by NASA and the U.S. Navy's Naval Air Systems Command. The first NASA plane to fly with fiber optic sensors was the F-15 Highly Integrated Digital Electronic Control (HIDEC) aircraft at Ames-Dryden Flight Research Facility, Edward, California. (NASA Release 92-23)

- It was reported that the spacecraft Ulysses had revealed unexpected changes in the violent vicinity of Jupiter since the last Earth probe flew past in 1979, including a swelling of the giant planet's magnetic field and an apparent abatement in volcanic eruptions on the Jovian Moon Io. (*W Post*, Feb 12/92; *NY Times*, Feb 12/92; *USA Today*, Feb 12/92; *W Times*, Feb 12/92; AP, Feb 11/92; *B Sun*, Feb 9/92; *P Inq*, Feb 9/92)

February 13: Senior members of the Bush administration launched the "National Technology Initiative," a program that would speed the movement of technology out of the Nation's huge Federal laboratories and into commercial markets. (*W Post*, Feb 13/92)

- Evgeny Sverdlov, director of the Institute of Molecular Genetics in Moscow, told the annual meeting of the American Association for the Advancement of Science (AAAS), that the demise of the former Soviet Union had created a "brain drain" that challenged the future existence of the Russian scientific research community. Because of the lack of funds, many research centers were on the verge of collapse. He added that it was good for young scientists to hone their skills abroad. But he said it would be a disaster for science in his country if they did not return. (*CSM*, Feb 13/92)

February 14: "Space Astronomy Update," a new television program launched by NASA, was scheduled for debut over NASA Select Television. The program, which was to originate from the NASA Headquarters auditorium, Washington, D.C., aimed to provide an understanding of how our views of the universe are changing through continuing, new results from astrophysical observations such as the Hubble Space Telescope, Compton Gamma Ray Observatory, and the Cosmic Background Explorer. (NASA Release 92-15)

- In an effort to inspire students to study mathematics, science, and technology, almost 1,000 engineers from NASA planned to visit schools nationwide during the week of February 16-22. NASA's "teachers for a day" will be participating in the National Engineers Week's Discover "E" Program, the largest student outreach effort sponsored by the engineering profession. NASA engineers were to participate in career day activities, teach students, conduct science competitions, participate in teacher workshops, and judge science fairs. NASA Administrator Richard H. Truly said, "Space exploration and its monumental engineering feats are vital to America's future competitiveness, will strengthen domestic economy, provide jobs for Americans, and inspire students to study mathematics and science." (NASA Release 92-24)

February 15: The Associated Press reported that two ex-Soviet cosmonauts circling the Earth went on television to reassure the public that they were safe and working hard, despite the many difficulties caused by the turmoil back home. The demise of the Soviet government and independence of the former republics had thrown the space program into disarray, delaying the cosmonaut's return for months. (*AP*, Feb 15/92)

February 16: Space Shuttle Discovery, which flew in space nine days in January, returned home after 14 days on the ground in California and a cross-country piggyback trip on a Boeing 747. The Shuttle left for the Kennedy

Space Center, stopping overnight at Biggs Army Air Field in El Paso, Texas and at Kelly Air Force Base in San Antonio, Texas. (AP, Feb 16/92)

February 17: It was reported that NASA's Johnson Space Center plans to award a broad computer services contract later during the year to support the center's host computers, networks, workstations, application software, and telecommunications systems. The contract, which analysts estimate will cost up to \$180 million, was to include software acquisition, development and maintenance, installation, engineering, integration, and customer services. (*Federal Computer Week*, Feb 17/92)

February 18: Scientists reported that enhanced versions of the pictures taken from the Voyager 2 spacecraft reveal what look like three gigantic ice-gushing volcanoes on Neptune's frozen Moon Triton. (*NY Times*, Feb 18/92; AP, Feb 14/92)

- Scientists working in Antarctica were seeking evidence of radiation from space. In one project, directed by Dr. Douglas M. Lowder of the University of California at Berkeley, a hot water jet drilled two holes 2,600 feet deep in the ice to test the possibility of detecting the elusive particles called neutrinos that after traveling through space, traverse the entire Earth to emerge at the pole. Scientists hope scanners in a series of such holes will be able to identify the sources of neutrinos in the Arctic sky. (*NY Times*, Feb 18/92)

February 20: NASA Administrator Richard H. Truly announced the appointment of Aaron Cohen, Director of the Johnson Space Center, Houston, as acting Deputy Administrator. Prior to being named acting Deputy Administrator, Cohen had been Director of the Johnson Space Center since October 1986. He joined NASA in 1962 in the Apollo Spacecraft Program Office at the Manned Spacecraft Center. (NASA Release 92-25)

February 23: After two failed launch attempts, the Earthwinds around-the-world balloon flight was postponed until November. The captain, airline pilot Larry Newman of Scottsdale, Arizona, and his crew, Don Moses and Russian cosmonaut Vladimir Dzhanibekov, need near-calm conditions on the ground and the right trajectory to launch the trip, expected to last from 12 to 21 days at an altitude of about 35,000 feet. It would be the first balloon to circle the world. (*LA Times*, Feb 23/92;)

- Yuri P. Semenov, general director of NPO Energia, the Russians' civilian manned space program, invited U.S. officials to lease room aboard the Mir Space Station, orbiting 240 miles above Earth, to conduct experiments. In addition, Semenov also proposed selling Russians' most powerful rocket, the Energia, which exceeds the lifting capacity of any U.S. launch vehicle. (*W Post*, Feb 23/92; *NY Times*, Feb 23/92)

- It was reported that a Delta 2 rocket carrying a \$65 million military navigation satellite was launched into space. The Global Positioning System "Navstar" satellite is the 12th in a globe-spanning network of such spacecraft that allow military forces on the ground, at sea, and in the air to determine their location and altitude to within 53 feet anywhere in the world. After a flawless boost into space, the satellite was released into a preliminary orbit about 25 minutes after liftoff. On-board rockets were scheduled to fire later to put the satellite in a circular 12-hour orbit 12,500 miles up. (UPI, Feb 23/92; *B Sun*, Feb 24/92; *W Times*, Feb 24/92; *USA Today*, Feb 24/92)

February 24: After triumphing in a bruising congressional battle in 1991 and securing a \$2.25 billion berth in the Administration's 1993 budget, NASA officials and Space Station Freedom contractors said they were on target toward a scheduled launch of the first Space Station components in November 1995. The station, to be lofted piece by piece aboard the Space Shuttle, was to be partially operational by 1997, and permanently manned by a four-astronaut crew by 2000. (*LA Times*, Feb 24/92)

- It was reported that a Russian-German space crew will blast off from Kazakhstan on March 17, 1992, the first manned flight since the birth of the Commonwealth of Independent States (CIS). German cosmonaut Klaus-Dietrich Flade was scheduled to travel aboard a Soyuz craft to the Mir Space Station, six weeks after his countryman Ulf Merbold returned from a successful eight-day mission aboard the U.S. Shuttle Discovery in January. Kayser-Threde GmbH, a small Munich high technology firm, would produce hardware for scientific tests during Flade's week-long mission. (Reuters, Feb 24/92)

- Associated Press reported that a military satellite capable of guiding warplanes, ships, and tanks with an accuracy of 50 feet or better circled Earth Monday after a ride on a Delta rocket. (AP, Feb 24/92)

- It was reported that Russian scientists successfully tested an engine for a space plane in 1991. (*Time*, Feb 24/92)

February 25: Milton B. Ames Jr., 78, an aeronautical engineer who was Mission Director for the Pegasus satellite launches using Saturn rockets and who was a recipient of numerous NASA awards, died of heart failure at Mount Vernon Hospital, Alexandria, Virginia. (*W Post*, Feb 25/92)

- Milan J. Krasnican, 68, a retired aerospace engineer with NASA, who was a member of the Project Mercury Space Task Group and a project engineer on the orbiting geophysical observatory spacecraft program at Goddard Space Flight Center, died at Sibley Hospital. A long-term resident of the Washington area, he lived in Bethesda. (*W Post*, Feb 25/92)

- According to a released congressional study, a \$3 billion U.S. space agency satellite program to monitor the environment would be useless without massive new computer technology. The study said that NASA would need the new technology to store and distribute the information its satellite program gathers. The Earth Observing System (EOS) was designed to take continuous measurements of ozone depletion, global warming, polar ice melt, depletion of rainforests, and other environmental developments. But the study also indicated that the data collected by EOS would require vast new ways to store information and make it available to a wide range of researchers. (Reuters, Feb 25/92; AP, Feb 25/92)

February 26: A new bearingless rotor system developed by McDonnell Douglas Helicopter Company, Mesa, Arizona, which promised to be a significant advance in helicopter technology, was tested by NASA. The tests, conducted in Ames Research Center wind tunnel, evaluated the rotor concept and gathered data to help develop computer programs needed to design a new generation of bearingless rotors. The new system, which eliminates hinges and bearings that usually connect the blades to the rotor shaft, is the key to the innovative system. The blades have advanced airfoils and are made of high strength composites. The technology was expected to have many benefits, including easier maintenance and lower fuel use. "The new rotor system would allow for faster, more agile, more cost effective and safer helicopters," said Steve Jacklin, project manager for the wind tunnel test at the Ames Research Center. (NASA Release 92-27)

- Reuters reported that two telecommunications satellites worth more than \$350 million were placed into orbit for Japan and the Arab League after launch from a European base in French Guiana. (Reuters, Feb 26/92)

- The General Accounting Office recommended that NASA should not award a planned contract for the data management portion of the Earth Observing System it had slated for deployment during the coming decade. Citing past criticism of NASA's handling of data from its space missions, the GAO report emphasized that the Space Agency should work toward the long-term viability of a new data system. (*W Times*, Feb 26/92)

- Fearing that unemployed scientists in the former Soviet Union might put their talents to use building weapons of mass destruction for unsavory regimes, the United States, Germany, and Russia announced the formation of an international center to promote "non-military endeavors." (*P Inq*, Feb 26/92)

February 27: Associated Press reported that three soldiers had burned to death as hundreds of construction troops rioted at Baikonur Space Center in Kazakhstan after complaining of "inhuman treatment" by their superiors. Baikonur was the main space launch site in the former Soviet Union. (*P Inq*, Feb 27/92)

- In a speech to the National Space Club, outgoing NASA Chief Richard Truly, who resurrected the Shuttle Space program after the 1986 tragedy, said that the country's space program is in jeopardy and that "the cheap shots" coming from the National Space Council, headed by Vice President Quayle, "must end" if the White House and Congress want to maintain U.S. leadership in space. (*USA Today*, Feb 27/92; *W Times*, Feb 27/92; *W Post*, Feb 26/92; *Fla Today*, Feb 15/92; *O Sen*, Feb 14, 1992; *Birmingham Post-Herald*, Feb 18/92; *Defense News*, Feb 17/92; *B Sun*, Feb 19/92; *Space News*, Feb 17/92; AP, Feb 19/92; *NY Times*, Feb 20/92)

- Congressional investigators said that the Space Agency's Earth-observing satellite program was flawed because of risky plans for gathering information from the satellites. (*NY Times*, Feb 27/92)

February 28: A status briefing marking the 20th anniversary of Pioneer 10's launch was scheduled for March 2 at Ames Research Center, Mountain View, California. The briefing was to examine new and past space accomplishments and a spacecraft signal was scheduled to be "piped in" to the briefing from five billion miles away. Also featured in the briefing would be a launch-identical, full-scale replica of Pioneer 10 shown for the first time. (NASA Note N92-16)

- The *Washington Post* announced that Representative Howard Volpe of Michigan had accused NASA of teaching workers how to avoid disclosing controversial information, including rewriting documents and destroying them. The congressman said that congressional investigators looking into a program to develop the SP-100 nuclear space reactor had found a two-page set of instructions on how to deal with Freedom of Information Act requests. (NASA Release 92-041, Feb 28/92; *Plain Dealer*, Feb 28/92; AP, Feb 27/92)

- Representative Richard J. Durbin, Illinois Democrat, and Senator Dale Bumpers, Arkansas Democrat, released a GAP analysis that said the Space Agency was committing itself to more projects than for which it could expect the country to pay. "In short, it is chasing too many programs for too few dollars." (*W Times*, Feb 28/92; AP, Feb 27/92)

- Dr. Lynn Wiley, an obstetrician who had worked with NASA since the early 1980s, reported that because of plans for long-term missions in space, the question of sex and reproduction had become very important issues. Men and women could be teamed in lunar colonization efforts planned after the turn of the century and in trips to Mars, which could take two to three years for a round trip. Dr. Stewart Whitman of the Space Settlement Studies Program at Niagara University agreed that research was "essential if males and females are going to be on long-term missions together." But Barbara Schwartz, a spokeswoman for the Johnson Space Shuttle Center, said Shuttle sex is not feasible because there is no "privacy" and stressed that NASA plans no sexual exper-

iments involving humans. (*W Times*, Feb 28/92; *Huntsville Times*, Feb 20/92; *Birmingham News*, Feb 20/92; *NY Times*, Feb 11/92)

- Yuri N. Koptev, a top Russian space official, declared in *Izvestiya*, that the six-year-old Space Station Mir must be replaced by 1994 and suggested turning to the West for technical and financial assistance. "We do not exclude attracting foreign capital and forming a joint stock company for joint use of the Mir Station," he said. (AP, Feb 28/92)

March

March 3: NASA selected 28 research proposals for immediate negotiation of Phase II contracts in NASA's Small Business Innovation Research Program (SBIR). The proposals were submitted by 65 small, high technology firms located in 16 states. Total value of the 28 awards was \$14 million. SBIR objectives are to stimulate technological innovation in the United States by using small business, including minority and disadvantaged firms, to help meet Federal research and development needs and to encourage commercial applications of federally funded research innovations. The SBIR program is managed by NASA's Office of Commercial Programs, NASA Headquarters, Washington, D.C., and all individual SBIR projects are managed by nine NASA Field Centers. (NASA Release 92-27)

March 4: A press briefing was scheduled to be held by a science team for the ATLAS-1 mission on March 23, 1992, at the Marshall Space Flight Center (MSFC), Huntsville, Alabama. The briefing was to discuss the mission's science activities and was to consist of two panels. (NASA Note N92-18)

- A \$25 million, five-year program to expand the ability of helicopter pilots to fly close to the ground, around obstacles and in bad weather, was initiated by NASA and the U.S. Army. Experiments conducted at NASA Ames Research Center, Mountain View, California, would study displays that give pilots information, better guidance and navigation systems, and ways to improve helicopter weapons systems. The program's main research tool would be a modified UH-60A Black Hawk helicopter called the Rotorcraft-Aircrew Systems Concepts Airborne Laboratory or "RASCAL." In addition to Ames, flight tests were also to be conducted at Crows Landing, a U.S. Navy facility in California's San Joaquin Valley. (NASA Release 92-28)

- NASA reported that an SR-71A "Blackbird" research aircraft will test a key propulsion system for the X-30 National Aero-Space Plane (NASP). The SR-71A would act as a high-speed testbed to prove the concept of burning hydrogen fuel outside the X-30's engine exhaust nozzles as a way to improve overall flight efficiency. If the program operations received approval, the SR-71A would be modified and flown at NASA Ames-Dryden Flight Research Facility, Edwards, California. The NASP Joint Program Office, Wright-Patterson AFB, Ohio, funded the preliminary design work for the experiment. The NASP program is a joint effort involving NASA, the Department of Defense, and a U.S. industry team. (NASA Release 92-29)

March 5: In an experiment co-sponsored by NASA and the Walter Reed Army Institute of Research, Washington, D.C., a novel cell culture system for growing bone cells was to undergo its first test in weightlessness on a Space

Shuttle mission. The objectives of the Space Tissue Loss-1 (STL) experiment involve studying the effects of the microgravity environment on the biochemistry and functional activity of various tissues including muscle, bone, and blood cells. Post-flight electron microscopic analyses of cells from the flight experiment were to be conducted by Dr. Stephen Doty of the Hospital for Special Surgery in New York City. (NASA Release 92-30)

March 6: David Wolf, Ray Schwarz, and Tinh Trinh of NASA's Johnson Space Center (JSC) were selected by NASA's General Counsel Office to receive the Inventor of the Year Award for their development and design of a new class of horizontally rotating tissue culture systems—also known as the rotating wall bioreactor—that in some ways simulate microgravity. Bioreactors are cell maintenance devices used for research in growth and culturing cells or tissues and have been recognized as valuable tools for pioneering research in lung tissue, skin growth, intestinal disease, cartilage growth, colon cancer, brain tumor growth, and therapeutics. (NASA Release 92-33)

March 9: NASA announced that more than 700 researchers from around the world would convene on March 16-20, 1992, at Johnson Space Center's (JSC) Gilruth Center in Houston, Texas for five days of discussions on research on the universe, with much of the focus on Venus and findings from NASA's Magellan probe. Magellan, deployed from the Space Shuttle Atlantis in 1989, has mapped about 97 percent of the Venusian surface with its remote sensing cameras. An overview of the Magellan program called "Magellan at Venus: The Global Perspective Emerges," was scheduled to start the conference on March 6, 1992. (NASA Note N92-19)

- A House panel raised legal questions about the National Space Council's handling of a proposal to restructure space program management. Representative Howard Wolpe of Michigan, chairman of the House Science subcommittee on investigations and oversight, charged in a letter to President Bush that the council's official circulation of the proposal was in conflict with the 1958 Space Act. The proposal, prepared by the Livermore Laboratory's Lowell Wood, also violated the council's charter not to interfere with line management responsibility in NASA. (*AvWk*, March 9/92)

- David A. Paige of the University of California at Los Angeles reexamined the thermodynamics of ice under Martian conditions and concluded that there could be some ground-ice deposits just a few feet below the surface and that "these deposits could be a valuable resource for human exploration." (*W Post*, Mar 9/92)

- Researchers reported in *Science* magazine that two groups of meteorites thought to be fragments of long-vanished planets had been dated to within 100 million years of the formation of the solar system about 4.56 billion years

ago. The research could lead to a better understanding of how planets emerged from the debris of interplanetary collisions. (*P Inq*, Mar 9/92)

March 10: NASA technology studies have indicated that a next-generation high-speed civil transport (HSCT) would be able to meet engine emission and noise targets, although the sonic-boom problem would remain. Agency studies had shown that emissions could be reduced to an acceptable level by controlling the fuel air ratio in the combustor to eliminate high peak temperatures. NASA was also studying new high-lift flaps that allow the aircraft to climb rapidly, reducing the noise footprint. (*Flight International*, Mar 10/92)

March 11: In an official statement, NASA Administrator Richard H. Truly welcomed the nomination of Daniel S. Goldin to be next NASA Administrator. "I am pleased to learn that President Bush nominated Daniel S. Goldin as the next Administrator of NASA....I wish him every success as he comes to this elite organization," said Truly. (NASA Note 92-20)

March 12: It was reported that on March 17, 1992, that the Aerospace Safety Advisory Panel will present its annual report to NASA Administrator Richard H. Truly at NASA Headquarters, Washington, D.C. The panel reviews, evaluates, and advises the NASA Administrator on present and future NASA programs and activities. Priority is given to programs that involve the safety of manned flight. (NASA Note 92-21)

- A congressional investigator recommended that the government scrap development of a space nuclear reactor unless the Nation was willing to commit more than \$2 billion to the project. The space reactor project was begun as a joint venture of NASA, the Department of Energy, and the Pentagon. The latter agency envisioned a use of the project in its Strategic Defense Initiative, the space-based nuclear defense shield. But Mark E. Gebicke, Director of NASA issues for GAO, said the proposed reactor suffered because NASA refused to identify a specific mission in which the nuclear technology would be used as a power source or propulsion system. (AP, Mar 12/92).

March 13: Dr. Everett Gibson of NASA's Johnson Space Center (JSC), Houston, Texas, Dr. Haraldur Karlsson, and scientists at the University of Chicago analyzed drops of water extracted from several meteorites believed to have come from Mars and concluded that the oxygen isotopes in the water were extraterrestrial. Photographs returned to Earth from the Mariner 9 and Viking spacecraft show features that suggest Mars once may have had a water-rich atmosphere and flowing water on its surface. Through the years, several meteorites have been collected on Earth that scientists have identified as Martian by comparing them to information gleaned by the Viking spacecraft. Six of these meteorites were used in the water extraction procedure. Findings

from the work completed by the team may answer some questions about the processes operating in the solar system. (NASA Release 92-35)

March 14: It was reported that Vice President Dan Quayle's National Space Council had tightened its control over space activities by dividing NASA's responsibility for the U.S. Moon-Mars project among several government agencies. Quayle released a directive, approved by the president, that assigns "major roles" to the Department of Defense and the Department of Energy while establishing NASA as the principal agency. (*Mercury News*, Mar 14/92)

- The new Space Shuttle Endeavour was hauled slowly to its seaside launching pad for work to ready the ship for an engine test firing in April and its maiden flight in early May. Mounted atop a powerful Apollo-era crawler-transporter, Endeavour began the 4 1/2 mile, six-hour trip to pad 39-B at 7:18 a.m. EST. Engineers spent the afternoon hooking up fuel lines and various mechanical, hydraulic and electrical systems. (UPI, Mar 14/92; AP, Mar 13/92; *P Inq*, Mar 14/92)

- In an effort to reduce vibrations in helicopters, a team of engineers at the University of Maryland were developing "smart" rotor blades that measure aerodynamic stresses and change shape in flight to reduce them. The team also hoped to build rotor blades that can warn pilots when the blades are about to crack or fail. (*B Sun*, Mar 14/92)

March 16: The Lunar and Planetary Science Conference in Houston, Texas, announced that the Magellan spacecraft's orbit around Venus would be lowered to just above the planet's dense atmosphere to conduct gravity studies on Venus. The spacecraft's closet approach to Venus was to be moved downward from 186 miles to 111 miles above the surface for maximum sensitivity to variations in the gravity field. The Magellan Project is managed by JPL for NASA's Office of Space Science and Applications. (NASA Release 92-36)

March 17: James V. Correale, 69, a native of Philadelphia who figured out how to clean the air that Apollo 13 astronauts rapidly were running out of during their mission to the Moon in 1970, died Saturday at a hospital in Nassau Bay, Texas. (*P Inq*, Mar 17/92)

March 18: Researchers from NASA's Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Virginia, used laser-ranging instruments aboard the Wallops P-3B (HL) Orion aircraft to measure the Arctic sea ice above the water and the Greenland polar glacier elevations in order to study global climate changes. The data gathered was to be compared to previous studies and used to develop a baseline for future studies. Scientists are interested in developing accurate measurements of sea ice and glaciers because changes in these systems may indicate trends in world climate. Appreciable changes in these

ice systems, such as increased melting, could directly affect global climate. (NASA Release 92-38)

- Managers at NASA's Compton Gamma Ray Observatory were implementing a new set of operating procedures because of a problem in the playback of recorded data. Scientific and spacecraft data was to be transmitted directly to the Tracking and Data Relay Satellite System (TDRSS) and then to a ground control center, without using tape recorders. However, because of the capability of TDRSS, using two of its spacecraft would enable nearly full coverage of each Compton orbit. This procedure will be used while an investigation continues into the cause of the problem. Compton Gamma Ray Observatory, the second of NASA's Great Observatories, was launched April 5, 1991, by the Space Shuttle Atlantis to study high-energy radiation from space. The spacecraft was developed and is managed and operated by GSFC for NASA's Office of Space Science and Applications, Washington, D.C. (NASA Release 92-39)

March 18: A German and two Russian astronauts were launched into space in the first space mission of the post-Soviet era. The 160 foot Soyuz TM-14 rocket was scheduled to rendezvous on March 19 with the Mir Space Station orbiting 200 miles above Earth. Russian officials hoped the launching would attract more foreign investment for future joint missions to help finance future space explorations. (*NY Times*, Mar 18/92; *W Post*, Mar 18/92; *LA Times*, Mar 18/92)

- The Aerospace Safety Advisory Panel, in its annual report to officials of NASA, questioned the Agency's decision to save money by eliminating several engine improvement programs, which could compromise the safety of future Space Shuttle flights. Although the panel said NASA was generally doing a good job on safety issues, the panel said it was unwise for the Agency to stop developing a new main combustion chamber for the engine and a new hydrogen fuel pump. (*NY Times*, Mar 18/92)

- A draft report issued by the National Research Council claimed that NASA was failing to provide the technological support needed by the U.S. aircraft industry to face down foreign rivals. The study raised serious questions about NASA's role in supporting basic technology that U.S. manufacturers of aircraft jet engines and components rely on in meeting international competition. (*LA Times*, Mar 18/92)

March 19: According to a poll commissioned by the company that built the U.S. Space Shuttle fleet, enthusiasm was waning for NASA's planned space station and President Bush's proposed missions to the Moon and Mars. Sixty-five percent of the Nation's registered voters currently favor building the space station, compared with 74 percent two years ago, and 78 percent in 1988. Support for an outpost on Mars, a goal announced by Bush during his first year in office, had slipped to 49 percent from 62 percent in 1990 and 66 percent in 1988. (*O Sen*, Mar 19/92)

- Hugo Wahlquist, of NASA's Jet Propulsion Laboratory, said that Italian and American scientists would spend nine to 12 months looking for signs of gravity waves—distortions in space and time caused by gigantic black holes—in tape recordings of radio transmissions between Ulysses and stations on Earth. Discovery of gravity waves would provide strong confirmation of Albert Einstein's theory of how the universe works, and could prove the existence of black holes. (*W Times*, Mar 19/92; AP, Mar 19/92)

March 20: NASA released to Congress a report on the Restructuring of the Earth Observation System (EOS). The system is the centerpiece of NASA's Mission to Planet Earth, a coordinated program to study the Earth's environment as a complete global system and is composed of two series of spacecraft to collect data over 15 years. "The restructured EOS program meets the concerns for a less costly more flexible program while maintaining the science observations needed to support global change research," said Dr. Lennard A. Fisk, NASA's Associate Administrator for Space Science and Applications. (NASA Note N92-22)

- A Russian-German crew docked with the Mir Space Station and was to relieve a Russian cosmonaut who had been orbiting over an extended period of time. The ITAR-Tass news agency reported that the TM-14 capsule docked on schedule. Cosmonauts Alexander Viktorenko and Alexander Kaleri would replace cosmonauts Sergei Krikalev and Alexander Volkov, who were scheduled to return to Earth on March 25. Germany paid \$24 million to send its astronaut Klaus Dietrich Flade into space. He was to spend six days studying the influence of zero gravity on the human body. (*P Inq*, Mar 20/92; AP, Mar 19/92)

March 24: The scheduled launch of Space Shuttle Atlantis was canceled because of fuel leaks, but NASA decided it was a fleeting problem that posed no danger. Launch Director Bob Sieck said he was confident the trouble was not a recurrence of the hydrogen leaks that grounded the Shuttle fleet for almost six months in 1990. The launch was rescheduled for the next day. (*W Post*, Mar 24/92; *NY Times*, Mar 24/92; *W Times*, Mar 24/92; *P Inq*, Mar 24/92)

- NASA announced that both tape recorders aboard the \$617 million Compton Gamma Ray Observatory were malfunctioning, and engineers directed the craft to not use the machines. Compton, a joint project of NASA and the European Space Agency, was built by the space and technology group of TRW under the direction of Daniel S. Goldin, the man selected by President Bush to become the new NASA Administrator. (*W Post*, Mar 24/92)

March 25: Michael Griffin, Associate Administrator of NASA, told an opening session of a NASA conference, that NASA was in trouble with the tax-

paying public because it had not been running efficient programs. Griffin said NASA risks losing support for its projects—like proposed returns to the Moon and manned missions to Mars—because the public perceives it is employing more people than it needs and not giving a good return for the money it spends. (*Birmingham News*, Mar 25/92)

- The Space Shuttle Atlantis and its seven-member crew was launched into orbit to begin eight days of around-the-clock research to probe the health of Earth's polluted atmosphere. Embarking on NASA's first manned "Mission to Planet Earth," Atlantis' flight was the first of 10 planned over the next decade to chart subtle atmospheric changes as the Sun's energy waxes and wanes slightly over a complete 11-year "solar cycle." (*W Post*, Mar 25/92; *USA Today*, Mar 25/92; *WSJ*, Mar 25/92; *B Sun*, Mar 25/92; *NY Times*, Mar 25/92; *AP*, Mar 25/92)

- It was reported that the Bush administration's commitment to keeping Russia's nuclear scientists employed by offering financial assistance and technical cooperation was running into obstacles as U.S. officials held up some deals and sent conflicting signals about others. Among the projects awaiting approval were requests by Federal agencies to acquire Russian-made plutonium, buy a Russian-made reactor for the U.S. space program, and join an international consortium with Russia and others to explore use of fusion energy. (*W Post*, Mar 25/92)

March 26: Outgoing NASA Administrator Richard H. Truly announced his support for using space to enhance education and his recommendation to administrator-nominee Daniel S. Goldin that NASA fly Barbara Morgan, who was a backup to Christa McAuliffe. (NASA Release 92-40)

- A TRW unit was served with a whistle-blower lawsuit alleging that the firm made fraudulent claims for payments on government satellite contracts. The suit, filed in U.S. District Court in Los Angeles, alleged that TRW's Space and Technology group in Redondo California Beach, used improper design standards for the spy, communications, and scientific satellites, then billed the government for the cost of correcting the errors. (*LA Times*, Mar 26/92)

- Russian cosmonaut Sergei Krikalev returned to Earth five months later than originally planned. The 33-year-old flight engineer's stint in space aboard the Mir Space Station had been originally scheduled to end in October. But because of the disintegration of the Soviet Union, money problems in Moscow, and Kazakh nationalism, he was asked to extend his space journey by almost five months, creating a predicament for him and making him a media celebrity. (*NY Times*, Mar 26/92; *USA Today*, Mar 26/92; *W Post*, Mar 26/92; *WSJ*, Mar 26/92; *B Sun*, Mar 26/92)

- Belgium's Prince Philippe, who is the nephew of King Baudouin and heir to the throne, called the crew members of the Space Shuttle Atlantis to congratulate them on their launch and to honor Dirk Frimout, the first Belgian in space. (AP, Mar 26/92; UPI, Mar 26/92)

March 28: The Bush administration announced that the government would import Russian technology for the U.S. space program. "We hope that this is the beginning of a long series of transactions not only with Russia but with Ukraine and with other republics," said one official. The United States was buying a small amount of plutonium fuel for space exploration as well as a reactor designed for the same purpose and four thruster rockets built to shift a satellite from one orbit to another. The administration also said that it has approved a license for a private American company to buy Russian thrusters. The sets of deals are worth an estimated \$14.3 million. (*W Post*, Mar 28/92; *P Inq*, Mar 28/92; *B Sun*, Mar 28/92)

- Astronauts aboard the Space Shuttle Atlantis photographed natural auroras and fired clouds of gas into space as they circled Earth for a fourth day. (*NY Times*, Mar 28/92; *P Inq*, Mar 27/92; *W Post*, Mar 27/92)

March 30: A 22-second Flight Readiness Firing (FRF) of the Space Shuttle Endeavour's three main engines was scheduled for Monday, April 6, 1992, at NASA's Kennedy Space Center, Florida. Prior to launch, a successful main engine test firing is required of all new Space Shuttle orbiters. A primary objective of the mission was to capture, retrieve, repair, and redeploy an INTELSAT-VI communications satellite that had been stranded in an incorrect orbit since March 1990. An additional goal was to demonstrate and verify Space Station Freedom EVA maintenance and assembly capabilities. (NASA Note N92-26)

- It was reported that a set of briefings on Endeavour's maiden flight were scheduled for April 7 and 8, 1992, at the Johnson Space Center, Houston (JSC). The Space Shuttle Mission STS-49 crew members were to rendezvous, capture, repair, and deploy the stranded International Telecommunications Satellite (INTELSAT) and test and evaluate a variety of Space Station Freedom assembly techniques during three space walks. (NASA Note N92-25)

- Dr. William B. Lenoir, NASA's Associate Administrator for Space Flight, submitted his letter of resignation to NASA Administrator Richard H. Truly, to be effective May 4, 1992. During Dr. Lenoir's tenure, NASA safely and successfully launched the Space Shuttle 17 times and completed a major restructuring of the Space Station Freedom program, reducing its development costs by \$6 billion, simplifying its subsystems and improving its on-orbit assembly process. (NASA Release 92-41)

- NASA officials added an extra day to the environmental mission of the Space Shuttle Atlantis so its seven-member crew could conduct more research on the atmosphere. (*P Inq*, Mar 30/92; *NY Times*, Mar 30/92; *USA Today*, Mar 30/92)

- James Edwin Webb, 85, whose work as the chief of America's Space Agency was instrumental in putting a man on the Moon, died March 27 at Georgetown University Hospital. During Mr. Webb's tenure, America's first manned space flight took place as well as the first orbital flight by John Glenn and the first walk in space by Edward White. (*W Times*, Mar 30/92; *USA Today*, Mar 30/92; *NY Times*, Mar 29/92; *W Post*, Mar 29/92)

- Chinese engineers blamed a faulty ignition circuit for botching the launch of an Australian communications satellite. Investigators checking the Long March-2E rocket that failed to blast off on March 22 found a fault in the ignition system circuits that led to an emergency engine shutdown. According to Chinese officials, the launch will be attempted again later during the year. (*P Inq*, Mar 30/92)

March 31: NASA announced the selection of 19 new astronaut candidates for the Space Shuttle program. The group consisted of four pilot astronaut candidates and 15 mission specialist astronaut candidates, including nine civilians and 10 military officers. The candidates, who were chosen from 2,054 qualified applicants, were to report to the Johnson Space Center, Houston, in August 1992 to begin a year of training and evaluation. (NASA Release 92-42)

- Atlantis' astronauts reported the loss of a second scientific instrument, a telescope probing galaxies millions of light years away. Controllers spent hours trying to restore the telescope but to no avail. The telescope, the only astronomical instrument aboard, accomplished 19 observations before the fuse blew. More than 34 were planned for the nine-day mission. (*W Post*, Mar 31/92; *USA Today*, Mar 31/92; *W Times*, Mar 31/92; *B Sun*, Mar 31/92; *NY Times*, Mar 31/92)

- In order to study the rarefied region that lies between 10 to 20 miles above the Earth, designers were developing a new class of robot airplanes to monitor zone depletion and global warming. A half-dozen companies were proposing drones designed to work at these altitudes, travel thousands of miles without refueling, or stay high in the sky for days, if not weeks, at a times. Some of the proposals are modifications of military models, while others harness unusual engines, airframes or materials. (*NY Times*, Mar 31/92)

- Scientists reported that an array of instruments that detect the faintest twitches in the Earth's gravitational field had for the first time taken the pulse of the planet's solid inner core. The discovery opens a new avenue for studying the detailed structure of the Earth's deep interior, from which physicists would be able to calculate the mass of the Earth's inner core and to infer com-

positions of both the inner and outer core. The achievement was expected to shed light on such enigmas as the nature of the electric dynamo believed to drive the Earth's wavering magnetic field. (*NY Times*, Mar 31/92)

April

April 1: Virginia Governor L. Douglas Wilder was scheduled to dedicate on Sunday April 5, the new Virginia Air and Space Center in Hampton, Virginia. The \$30 million facility, which was to serve as the new official visitor center for the NASA Langley Research Center, has a 300-seat IMAX theater and was to feature exhibits on the Viking Orbiter and Viking Lander, as well as numerous exhibits on the history of flight and space exploration. (*W Post*, Apr 1/92)

- At the request of Congress, a NASA team researched the issue of killer asteroids and concluded that the odds of a major collision in the next century were “extremely small.” But the team added that asteroid impacts posed “a significant hazard to life and property” and called for an international effort “to provide insurance for our planet against the ultimate catastrophe.” The reporting team gave no cost estimates for the endeavor but said if construction began soon, a worldwide network of warning telescopes could be operational by 1997. (*NY Times*, Apr 1/92; *W Times*, Apr 1/92)

- A technical consultant to the House Committee on Space, Science, and Technology, said that if the hypersonic National Aerospace Plane is built, it would be assembled in Palmdale, California. Scott Crossfield, a former test pilot, said President Bush, Vice President Quayle, and the National Space Council were strong supporters of the X-30. Crossfield said it would cost an estimated \$5 billion to \$12 billion for the pair of X-30s. (*Antelope Valley Press*, Apr 1/92)

- NASA reported that the Agency would start supersonic flight tests of a new electronic control system that would improve the performance, reliability, and safety of high-speed military aircraft, future commercial supersonic transports, and the X-30 National Aerospace Plane. A NASA F-15 research aircraft was to begin supersonic testing at the Performance Seeking Control in April 1992 at NASA's Ames-Dryden Flight Research Facility, Edwards, California. (NASA Release 92-44, Apr 1/92)

April 2: After winning Senate approval in near-record time, Daniel S. Goldin was sworn in as NASA's ninth Administrator. (*WP*, Apr 2/92)

- The Space Shuttle Atlantis made a near-perfect touchdown at Cape Canaveral after a nine-day atmospheric research flight, NASA's first manned “Mission to Planet Earth.” Atlantis' ambitious flight marked the first in a series of at least 10 such missions to study the Sun and Earth's atmosphere over the next decade to chart subtle changes in the Sun's energy output that affect chemical processes critical to life on Earth. The Shuttle circled the world 143

times during its nine-day voyage and traveled 3.7 million miles. (UPI, Apr 2/92; AP, Apr 2/92)

- U.S. officials announced a tentative agreement between the United States and Europe limiting government support for the commercial aircraft industry. The deal would cap government support to Airbus for developing new aircraft at 30 percent to 35 percent of production costs. The sort of indirect support that the Europeans had charged U.S. manufacturers with receiving would be limited to 5 percent of a company's sales of civil aircraft. (*B Sun*, Apr 2/92; *LA Times*, Apr 2/92; *WSJ*, Apr 2/92; *NY Times*, Apr 2/92)

- Loral Corporation became the first U.S. aerospace company to win government approval to buy advanced space technology from the former Soviet Union. The Defense Department authorized Loral's space systems division in Palo Alto, California, to import tiny electric satellite thrusters that are used to position satellites in space. Loral's Russian partners are Fakel Enterprises of Kaliningrad, which makes the so-called Hall thrusters, and the Research Institute of Applied Mechanics and Electrodynamics of Moscow. (*WSJ*, Apr 2/92)

- Orbital Sciences Corporation of Fairfax, Virginia, said it had successfully launched a rocket-borne telescope from a site north of Fairbanks, Alaska. The telescope, sponsored by the Strategic Defense Initiative organization, would monitor infrared characteristics of the aurora borealis, commonly known as northern lights. (*W Times*, Apr 2/92)

- It was reported that for the first time in a generation, NASA and the Air Force were developing a new rocket engine and launch system. The National Launch System (NLS), which was to consist of three new vehicles, would become operational in 2002, and will, among other missions, carry supplies to Space Station Freedom. (*W Times*, Apr 2/92)

- NASA announced the selection of 33 participating scientists to take part in a wide range of investigations on the Mars Observer mission, planned for launch September 16, 1992. These scientists would be added to the current science teams in October 1992 to increase the range of studies planned for the 2-year global mapping mission. Besides representing U.S. universities and research centers, the newly selected group of participating scientists included four individuals from the United Kingdom, France, and Germany. Six scientists from Austria, the United Kingdom, France, and Germany were already involved in the mission, and a group of 10 participating scientists from Russia were to be added later this year. (NASA Release 92-45)

- NASA selected the ColeJon Corporation of Cleveland, Ohio, for negotiations leading to award of a support service contract for operations, maintenance, and repair of facilities at NASA's Lewis Research Center, Cleveland,

Ohio. Estimated value of the contract was approximately \$30 million. (NASA Release C92-3)

April 3: NASA Administration Daniel S. Goldin said President Bush's goal of a manned flight to Mars by 2019 was unrealistic because it would take longer to develop the spaceship and fly the robotic missions that must precede humans. (*USA Today*, Apr 3/92)

- A space-for-rent company unveiled its first Shuttle module, which is scheduled to fly aboard Atlantis in the spring of 1993. The Spacehab module, which consists of up to 61 lockers for experiments, would be the first privately owned and operated space facility that can be tended by astronauts in orbit. (*AP*, Apr 3/92)

April 4: NASA started a countdown toward test-firing the Space Shuttle Endeavour's main engines. Endeavour's three main engines were to be fired for 22 seconds. If all goes well, launch teams would begin preparing the Shuttle for a satellite rescue mission in early May 1992. (*W Times*, Apr 4/92; *AP*, Apr 4/92; *UPI*, Apr 6/92)

April 7: China reported that it would send astronauts into space by the year 2000 as the first step toward launching its own Space Station. "Before the year 2000 China will have completed its research into experimental manned spacecraft and carrier rockets," said the State Commission on Science and Technology. (*UPI*, Apr 7/92; *LA Times*, Apr 8/92)

- It was reported that a recently discovered galaxy, 13 billion light-years from Earth, may provide answers about the early formation of the universe. Researchers studying the galaxy, designated 10214+4724, said they believe it is forming new stars at more than 10 million times the rate of the most prolific star-forming mass in the Milky Way. (*NY Times*, Apr 7/92)

- In a letter sent to the chairwoman of the subcommittee that funds NASA, Senator Howell T. Heflin said killing the Advanced Solid Rocket Motor (ASRM) would cost almost twice as much as building it. NASA and the White House had moved to cancel the \$3 billion program, saying the cost of keeping it going would not fit in NASA's tight budget request of \$15 billion for fiscal year 1993. Using figures obtained from NASA and from the ASRM's contractors, Heflin calculated that killing the program would cost NASA \$2.65 billion through the year 2000. By contrast, he said it would cost \$1.29 billion to finish building the rocket, not including \$510 million to buy the first six sets of motors. (*Htsvl Times*, Apr 7/92; *Birmingham News*, Apr 12/92)

April 8: NASA managers decided to replace all three main engines aboard the Space Shuttle Endeavour because of problems with powerful oxygen

pumps that came to light after an engine test firing. Rocket engineers initially believed that Endeavour had sailed through its flight readiness firing in good condition, with no signs of any major problems in the ship's propulsion system. But detailed analysis of data from the 22-second test indicated the liquid oxygen high pressure turbopump bolted to main engine No. 2 had experienced high vibration levels during engine operation, apparently because of abnormal bearing wear. NASA decided to replace all three of the engines to minimize the impact on the Shuttle's launch processing. (UPI, Apr 8/92; AP, Apr 8/92)

April 9: Astronomers using the Hubble Space Telescope announced that they had spotted the gathering of swirling stars that is believed to be the gravitational signature of a black hole in a galaxy called M32. Todd R. Lauer of the National Optical Astronomy Observatories in Tucson, Arizona, and a scientist using the Hubble, said that based upon what he has seen so far, "I would be surprised if M32 turns out not to be a black hole." Concurrently, the Compton Gamma Ray Observatory discovered 11 objects in space that constitute "a new class of objects—the gamma ray quasar." The new gamma ray quasars, some as far as 10 billion light-years away, are probably similar to the thousands of other quasars detected in recent years, but the nature of quasars is still debated. (AP, Apr 9/92; *B Sun*, Apr 9/92; *LA Times*, Apr 9/92; *W Times*, Apr 9/92; *U Post*, Apr 13/92; *USA Today*, Apr 9/92; CSM, Apr 14/92; NASA Release 92-46 and 92-47; NASA Note N92-28)

- Seven scientists, engineers, and government officials told a congressional subcommittee that the often cited claim by National Science Foundation officials that the United States faces a major shortage of scientists and engineers was false. Witnesses told the hearing that the shortage that was to have begun a few years ago—and which was to have left the Nation with a "shortfall" of 675,000 scientists and engineers by 2010—never materialized. Quite the contrary, they said, there was now such a surplus of scientists and engineers that unemployment rates in some disciplines far exceeded those for the country as a whole. (*W Post*, Apr 9/92; *B Sun*, Apr 14/92)

April 10: Senator Barbara Mikulski of Maryland called for immediate congressional action to shift U.S. research and development from military hardware to products that would compete in the "environmental marketplace" of the future. NASA, she said, should develop "the second-generation Concorde...and leapfrog our competitors in a 21st century industry that will generate a \$200 billion market of the future." (*W Post*, Apr 10/92)

April 11: Spencer Moxon Beresford, 73, a former general counsel for NASA under President Nixon, died April 7 in an automobile accident in Miami. (*W Post*, Apr 11/92)

- The University of Maryland received \$20 million from NASA to help build and equip the Christopher Columbus Center of Marine Research and Exploration. (AP, Apr 11/92)

April 13: According to Michael Griffin, NASA's Associate Administrator for exploration, NASA needs \$3 billion annually to conduct a program of human exploration of the Moon and Mars. Those funds would have to come from sacrificing other space projects if NASA's overall budget could not be increased, Griffin said. (*Space News*, Apr 13/92)

- TRW Inc. said it had named R. Gordon Williams to succeed Daniel S. Goldin, the new head of NASA, as vice president and general manager of TRW's Space and Technology Group. Williams, 61, was formerly vice president and general manager of TRW's Federal Systems division, which manages TRW's major space systems and projects for NASA. (UPI, Apr 13/92)

April 15: The National Space Club named the NASA/TRW observatory team that built the Compton Gamma Ray Observatory the winner of the 1992 Nelson P. Jackson Award at an April 10 awards ceremony in Washington, D.C. This award honors the firm responsible for "an outstanding contribution to the missile, aircraft, and space fields." (*Business Wire*, Apr 15/92)

April 17: A space agency spokesperson said that NASA had failed again to open the main antenna of its Jupiter-bound Galileo spacecraft. Engineers had heated the antenna with sunlight over three days in March, then cooled it in shade. They hoped the antenna would expand and then shrink enough to free its jammed parts, said Jim Wilson, a spokesman for the Space Agency's Jet Propulsion Laboratory. (*P Inq*, Apr 17/92; *USA Today*, Apr 17/92)

April 18: It was reported that in the upcoming flight of the Shuttle Endeavour, NASA would try for the first time to revitalize a crippled satellite while in orbit. During a four-day procedure, Endeavour's crew were to rendezvous with Intelsat 6, pull the satellite into the spaceship's cargo bay and mate it to a new solid rocket motor. Intelsat 6 then would be released and its rocket motor fired to send it into a 22,300 mile-high orbit. The hope was that then, for the next 14 years, Intelsat 6 would relay trans-Atlantic telephone calls and television shows from Europe to North America and South America. (*W Times*, Apr 18/92)

April 19: NASA officials said that tomatoes grown by students and teachers from seeds that had been in space for nearly six years show little or no difference from the fruit of seed that never left the Earth. The tomatoes from a batch of 12.5 million space-borne seed were as healthy as their earthly counterparts, though "findings suggest that the space-exposed seeds germinated slightly faster" and "seedlings had a faster initial growth rate," the officials said. (*W Times*, Apr 19/92; *W Post*, Apr 20/92; NASA Release 92-49)

April 20: It was reported that a NASA-led team might travel to Russia to explore areas for joint cooperation on axisymmetric scramjets. At the top of the list was the possibility of the U.S. joining in a second flight later during the year of the Russian scramjet that already had achieved about three seconds of supersonic combustion. (*AvWk*, Apr 20/92)

- Explorers who uncovered the lost Arabian city of Ubar by using ancient maps and photographs from space have also found a bigger site. The second site, at the base of Oman's Qara Mountains about 20 miles northeast of the Indian Ocean port of Salalah, was called Saffara Metropolis on the map of Roman historian Claudius Ptolemy, drawn around A.D. 100, said Juris Zarins. Zarins said the find indicates an Arabian Peninsula network of frankincense trade existed more than three millennia before scholars previously believed. (AP, Apr 20/92; *P Inq*, Apr 21/92)

- NASA awarded research grants to three universities to develop teacher training courses that would enable middle school teachers to incorporate aerospace topics and concepts into their classrooms and to create new and imaginative practices in learning. The Teacher Training Pre-Service Program is a two-year program. The following schools were selected from responses to a solicitation of proposals: Fayetteville State University, Eastern Michigan University, and the University of Alabama. Each was to receive a \$83,000 grant and were expected to provide matching, non-Federal funds. (NASA Release 92-50)

April 21: American space scientists said the hottest star ever recorded—33 times hotter than the Sun—had been photographed in a faraway galaxy by the Hubble Space Telescope. Burning at 360,000 degrees Fahrenheit, the white star at the heart of a glowing red nebula in the Great Magellanic Cloud galaxy is going out in a "blaze of glory," said Sally Heap, an astrophysicist with NASA. (*NY Times*, Apr 21/92; AP, Apr 21/92; *W Times*, Apr 21/92; *USA Today*, Apr 21/92)

April 23: The Justice Department accused a large military electronics maker of falsifying results of tests on sophisticated weapons and spacecraft, including the Space Shuttle. The department joined a \$250 million civil lawsuit that accused Teledyne Relays, a Teledyne Inc. unit, of falsifying tests to ensure the reliability of electromagnetic relays, according to court papers. Government contracts accounted for about a third of Teledyne's \$3.2 billion in sales last year. (AP, Apr 23/92)

- The Magellan spacecraft, which had used radar to unveil 97 percent of Venus' cloud-covered volcanic landscape, started measuring the planet's gravity. Magellan showed that Venus' crust is built up vertically as volcanoes erupt, adding material to the surface. The measurements should help scientists

understand the planet's interior and how internal activity shapes the rugged surface. (*NY Times*, Apr 23/92)

- Daniel S. Goldin, the newly appointed NASA Administrator, said he was a strong supporter of the controversial Space Station Freedom, which was being developed in part at the NASA Lewis Research Center in Cleveland. The Space Station Freedom, whose price had soared from \$8 billion to \$40 billion, was a frequent target of lawmakers looking to trim NASA's budget. But Goldin said, "I believe that there is a crying need for human interaction in space. If we are to fulfill our role of NASA and to have humans seek their destiny in space, we must understand the interactions of humans in a hostile space environment, the long-term impacts of zero gravity, microgravity, radiation." (*News-Herald*, Apr 23/92; *Plain Dealer*, Apr 23/92)

- It was announced that NASA's Cosmic Background Explorer (COBE) satellite had achieved two of the three goals of its \$400 million mission to study the "big bang." In 1991, COBE had shown that the wavelength or "color" of the cosmic background radiation was consistent with what the big-bang theory predicted, said John Mather, project scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Scientists also said that COBE had met its second goal: detecting the oldest structures in the universe, thereby explaining how matter first started clumping together in the young universe to produce galaxies and stars. COBE was launched from Vandenberg Air Force Base on November 18, 1989. It was carried into a 559-mile-high, near polar orbit by a two-stage Delta rocket with nine strap-on boosters. (*AP*, Apr 23/92; *LA Times*, Apr 24/92; *B Sun*, Apr 24/92; *NY Times*, Apr 24/92; *USA Today*, Apr 24/92; NASA Release 92-51)

April 24: During the Soviet period, Ukrainian scientists and industry were an integral part of the Soviet space program, which employed over 250,000 people. When the breakup of the Soviet Union fragmented its space program, Ukraine gained one of the world's most advanced aerospace industries, capable of producing everything from rockets to satellites. However, without the Soviet Union to pour money into space exploration, Ukraine was looking for new ways to keep its aerospace industry working. (*LA Times*, Apr 24/92)

- Flights of the X-31 enhanced fighter maneuverability demonstrator aircraft resumed at NASA's Ames-Dryden Flight Research Facility, Edwards, California. The X-31s were being flown at Ames to show the value of thrust vectoring (directing engine exhaust flow) coupled with an advanced flight control system for close-in air combat at very high angles-of-attack. (NASA Release 92-52)

April 26: The Air Force reported that a Titan 2 rocket was launched into space carrying a secret military payload into a polar, low-Earth orbit. The two-stage

rocket, a modified Titan intercontinental ballistic missile, was launched from Vandenberg Air Force Base, about 250 miles northwest of Los Angeles. (*W Times*, Apr 26/92)

April 28: NASA delayed the maiden flight of the new Space Shuttle Endeavour from May 4 to May 7 to allow a daylight liftoff. Tom Utsman, acting Associate Administrator for Space Flight at NASA, said officials had reviewed the criteria and decided that it would be prudent to delay the flight so detailed photographs and documentation could be made for analysis. A daylight liftoff also would allow Endeavour's seven-member crew to make a daylight landing back at the Kennedy Space Center in case of an engine failure early in flight. (UPI, Apr 28/92; *W Post*, Apr 28/92; *USA Today*, Apr 28/92; *NY Times*, Apr 28/92)

April 29: NASA Administrator Daniel S. Goldin predicted a "Perils of Pauline" battle in Congress over the survival of Space Station Freedom, saying the outpost was an investment in the future that should not be squandered for short-term gains. Despite the high costs and frequent redesigns, Goldin said the station was vital to the future of America's space program. Although he refused to predict the outcome of congressional debate, he expressed guarded optimism that Freedom would survive the latest challenge. (UPI, Apr 29/92)

- Gerard K. O'Neill, a visionary Princeton physicist who popularized the idea of colonizing space, died in Redwood City, California. O'Neill, 65, was the author of *The High Frontier*, a 1977 book that proposed the construction of giant solar-powered cylinders in which as many as 20 million people could live in space. (*P Inq*, Apr 29/92)

- The Air Force reported that a YF-22 Advanced Tactical Fighter, prototype of the planned F-22, had slammed onto the main runway of Edwards Air Force Base with its wheels retracted during a practice approach. The radar-eluding plane, designed to be the hottest air combat fighter going into the 21st century, slid several thousand feet and burned for 90 seconds. A Lockheed pilot escaped with only minor injuries. (*B Sun*, Apr 29/92)

- Opponents of Space Station Freedom, led by Representative Tim Roemer of Indiana, said they would try to strip from the 1993 Federal budget virtually all of the \$2.25 billion requested for the project by NASA. The attack would come as an amendment to legislation that would set maximum spending levels for the Agency over the next three years. (*LA Times*, Apr 29/92)

- NASA Administrator Daniel S. Goldin announced his first hiring decisions, naming four men to senior management posts at NASA Headquarters. The new appointments—Maj. Gen. Jeremiah W. Pearson III, Bryan D.

O'Connor, Charles F. Bolden, and Frederick D. Gregory—including three present or former astronauts and a Marine general who led forces during Operation Desert Storm. (*W Post*, Apr 29/92; NASA Release 92-54)

April 30: The planned U.S. Space Station Freedom survived an attempt to kill it when the House of Representatives defeated a move to cut the \$2.25 billion needed to keep the program on track. The 254-159 vote to continue funding marked the fourth time the House had voted on the costly and ambitious program in recent years. (UPI, Apr 30/92; AP, Apr 30/92; *W Post*, Apr 30/92; *USA Today*, Apr 30/92)

- Russia faced a new dispute over the famed Baikonur spaceport in Kazakhstan. Russian President Boris Yeltsin revealed that Kazakhstan had prevented the liftoff of a satellite at the Baikonur cosmodrome. "Kazakhstan was playing games. It wanted to show that there has to be a Russian-Kazakhstan agreement on Baikonur," Mr. Yeltsin said. Mr. Yeltsin said he would propose to Kazakhstan President Nursultan Nazarbayev either joint financing of the famed spaceport, Russian purchase of the property, or a form of joint venture with the Kazakhstan republic. (*W Times*, Apr 30/92)

- Results from a recently completed U.S. multi-agency aircraft study indicated that the ozone shield of the Northern Hemisphere was increasingly vulnerable to depletion by man-made chemicals. Dr. James Anderson of Harvard University, the study's Mission scientist, and 80 other scientists of the second Airborne Arctic Stratospheric Expedition (AASE II) used two NASA aircraft to examine the ozone-related chemistry and air motions of the lower stratosphere from early October 1991 through late March 1992. The extensive measurements, combined with satellite and meteorological data, provide the first detailed picture of the factors that drive changes in the Arctic ozone layer from fall, through winter, and into spring. (NASA Release 92-55; NASA Release 92-56)

May

May 1: NASA Headquarters reported that eight finalists had been chosen for the 1992 George M. Low Trophy—NASA's Quality and Excellence Award. The finalists were: Cray Research Inc., Honeywell Inc., IBM Federal Sector Division, McDonnell Douglas Space Systems, Paramax Systems Corp., Rocket Research Co., Stanford Telecommunications Inc., and Technical Analysis Inc. (NASA Release 92-57)

- NASA scientists, reviewing results of seven months' observations, said that after a record buildup of ozone-damaging chemicals last January, the amounts rapidly dissipated because of sudden warming in February and March. While the tests continued to show a thinning of the ozone layer that protects the Earth from ultraviolet rays, the sudden warming prevented any severe ozone depletion over the Arctic region, the scientists said. Nevertheless, they said, the potential for severe ozone destruction over parts of the United States, Canada, and Europe remains a matter of serious concern because of the high concentrations of destructive chlorine that were detected. (*W Times*, May 1/92; *NY Times*, May 1/92; *W Post*, May 1/92; *USA Today*, May 1/92; *LA Times*, May 1/92)

May 2: Scientists probing river muck have discovered bacteria that can “eat” the main chemicals threatening the ozone layer, the U.S. Geological Survey reported. The bacteria that break down chlorofluorocarbons, known as CFCs, were found along the Potomac River in Virginia and in pond, marsh, and swamp sediments in Maryland, South Carolina, and Virginia. The CFC-eating bacteria are harmless to humans, but can operate only in the absence of oxygen, according to Derek Lovley, a microbiologist working at the Geological Survey in Reston, Virginia. (*W Post*, May 2/92)

May 3: Senate leaders announced the appointment of Harriett G. Jenkins, Assistant Administrator for Equal Opportunity Programs at NASA, to head the Senate's new office of fair employment practices. Carl D. Moore, general counsel for the General Accounting Office's personnel appeals board, was named Deputy Director in a joint appointment by Majority Leader George J. Mitchell of Maine and Minority Leader Robert J. Dole of Kansas. (*W Post*, May 3/92)

- If Japan follows through on plans to launch a probe toward Mars in 1996, it will become the third Nation to explore the red planet, following the U.S. and Russia. Budgeted at \$96.8 million, the 550-pound Japanese probe has been dubbed Planet B. It would begin to orbit Mars by October 1997, according to Japan's Institute of Space and Astronomical Science, which is planning the project. (*Parade Magazine*, Mar 3/92)

May 4: Preston Rogers Bassett, 100, an inventor and retired president of the Sperry Gyroscope Co. who served on the National Advisory Committee for Aeronautics from 1954 to 1958, died of cardiac arrest April 30 at his home in Ridgefield, Connecticut. (*W Post*, May 4/92)

May 5: The House of Representatives approved a \$47.3 billion space program for the next three years after voting to limit spending on development of an advanced solid-fuel rocket motor. The bill reauthorizing NASA for fiscal years 1993 through 1995 was passed by voice vote and sent to the Senate. The House included \$7.5 billion for the proposed manned Space Station, nearly \$8 billion for other space science applications, and \$12.5 billion for the space shuttle program. Before approving the bill, the House agreed to cut in half, to \$260 million, the 1993 budget for the next generation solid-fuel rocket, designed to enable the Space Shuttle to carry heavier payloads, including key components of the Space Station. (*AP*, May 5/92)

- Thorsten L. Gunther, 76, a retired geodesist who worked on Goddard Space Flight Center contract involving Earth measurement, died April 25 at Washington Hospital Center of complications after surgery for an arterial aneurism. A resident of Washington area since 1947, he lived in Bethesda. Gunther was an expert on satellite geodesy and author of the NASA directory of station locations. (*W Post*, May 5.92)

May 6: NASA Administrator Daniel S. Goldin announced the selection of Darleen A. Druyun as chief of staff. The Chief of Staff facilitates communications between the Administrator's office and senior staff members, as well as with private sector executives and international visitors. In addition, the chief of staff focuses on internal NASA Headquarters management and operations, aiming to increase the efficiency of the organization. (NASA Release 92-58)

- NASA Administrator Daniel S. Goldin appointed Dr. Charles J. Pellerin, Jr., to the position of Deputy Associate Administrator for Safety and Mission Quality. Pellerin was also to serve as Special Assistant to the Administrator for Long-Range Planning. (NASA Release 92-59)

May 7: NASA's Goddard Space Flight Center, Wallops Flight Facility, Wallops Island, Virginia, selected the New Mexico State University, Physical Science Laboratory of Las Cruces, New Mexico, to negotiate a cost contract for the operation and maintenance of scientific balloon facilities and engineering support for the NASA Balloon Program. The total cost for the 5-year program was \$65 million. (NASA Release C92-6)

- NASA's Hubble Space Telescope revealed an unusual new optical jet in the nucleus of the elliptical galaxy NGC 3862. NGC 3862, also known as 3C264, is a bright radio source and x-ray source. It is the sixth brightest galaxy in a

rich cluster of galaxies known as Abell 1367, located at a distance of about 260 million light-years away in the constellation Leo. (NASA Release 92-61)

- In a mission called "La Chalupa 30," four men were to conduct investigations in an underwater habitat without any direct outside human contact for 30 days, giving the Behavior and Performance Laboratory at NASA's Johnson Space Center, Houston, the opportunity to study team performance as part of its continuing investigation to identify pertinent psychological issues for long duration space flight. "The mission will serve as an environment which is analogous to future extended space missions on the Shuttle or Space Station," said Dr. Al Holland, head of the Behavior and Performance Laboratory. (NASA Release 92-62)

- NASA Administrator Daniel S. Goldin said he found employees worried that the space agency was letting outsiders set priorities, allowing buildings to decay and wasting its skills by using contractors. "There seems to be a concern we overpromised in the beginning on technical issues and tend to underestimate costs...There is concern about future funding of new activities and the agency's ability to set priorities. They feel we must take charge of our destiny," Goldin said. (*Fla Today*, May 7/92)

- The names of Michael Adams and Manley "Sonny" Carter, two astronauts who died in the line of duty, were scheduled to be added to the \$6.2 million Space Mirror memorial at Kennedy Space Center. The 50 foot by 42 foot memorial was conceived as a way to pay tribute to the seven astronauts who died aboard the Space Shuttle Challenger in 1986. But it became a memorial for all U.S. astronauts who had died in the line of duty. The names of Adams and Carter, who died in 1991 in a commuter plane crash on their way to a NASA speaking engagement, were added to the memorial when workers were repairing cracks that had developed around the astronauts' names, which are cut through black-granite panels. (*O Sent*, May 7/92)

- The Senate, defying veto threats by the White House, adopted an \$6.3 billion savings package that demanded deep cuts in President Bush's military and space priorities, including the Strategic Defense Initiative. Approved 61-38, the measure would take \$1.3 billion from prior appropriations for SDI and \$1 billion from production funds for the B-2 bomber. The cuts from the space program, though much smaller, dealt a further blow to exploration of Mars, and they would kill an on-going project to design a high-speed aircraft capable of orbiting into space after launch from a conventional runway. (*WSJ*, May 7/92)

May 8: NASA delivered a report to the U.S. Senate outlining a shift in emphasis towards smaller, lower cost and more frequent planetary missions. The Small Planetary Mission Plan, which was requested by the Senate

Committee on Appropriations, Subcommittee on VA, HUD, and Independent Agencies chaired by Senator Barbara Mikulski, described two proposed missions that NASA had selected for preliminary studies leading to launches in 1996 and 1998. The two missions were the Mars Environmental Survey Pathfinder and the Near Earth Asteroid Rendezvous. (NASA Release 92-63)

- Lending their expertise with long-duration exposure to microgravity, the Skylab IV astronaut crew was scheduled to participate in a series of underwater tests that would help in the development of Space Station Freedom. The tests will be monitored by engineers represented by NASA, the Boeing Defense and Space Group, and international partners from the European Space Agency and the Japanese Space Agency. (NASA Note N92-42)

- It was reported that Martin Marietta Corporation had abandoned the six-year venture into the commercial satellite launching business that it started in the summer of 1986, seven months after the explosion of the Shuttle Challenger. The original plan was to build 20 Titan rockets for commercial launches. That number was reduced to 12, and the company charged \$90 million to fourth-quarter earnings in 1988 for a reserve to help finance the launch venture. Martin eventually built only four commercial Titans, the last of which was scheduled for launch in September 1992, carrying a payload to map the surface of Mars and look for possible landing sites on that planet. (*B Sun*, May 8/92)

- Thomas O. Paine, 70, who was Deputy Administrator and Administrator of NASA from 1968 to 1970, died of cancer May 4 at his home in Los Angeles. In 1985, President Reagan named him chairman of the National Commission on Space to set goals for future space exploration. He also was a member of Vice President Quayle's Advisory Committee on the Future of the U.S. Space Program. After leaving NASA, he returned to GE where he became a vice president and power generation group manager. In 1982, he retired from the Northrop Corporation as its president. (*W Post*, May 8/92; *NY Times*, May 7/92)

- Albert Parry, 92, a professor emeritus of Russian civilization and language and founder and former chairman of the department of Russian studies at Colgate University, died in Los Angeles. In 1954, Dr. Parry warned in an article that the Soviets would soon be able to launch a space satellite, and in another article published in July 1957, he predicted the launching would occur on September 17. The Soviet Union launched Sputnik I on October 4. (*NY Times*, May 8/92)

May 9: A research arm of Johns Hopkins University was chosen to design a spacecraft intended to take the first close-up look at the kind of asteroid that could one day collide with Earth. Hopkins' Applied Physics Laboratory in Laurel, Maryland, was given a \$450,000 contract by NASA for preliminary work on the Near Earth Asteroid Rendezvous satellite, called NEAR. If

NASA and Congress approved construction of the compact \$150 million spacecraft, it could begin orbiting an asteroid called "nereus" in January 2000. (*B Sun*, May 9/92)

May 10: It was reported that the Kennedy Space Center was about to break ground on a second Space Station project, a new building to service the outpost's propulsion modules. The 3,000 square foot building, to be located behind and south of the operations and checkout buildings in Kennedy Space Center's industrial area, would be the space center's third hazardous processing plant. This one was to be dedicated to servicing a single type of payload: 800-gallon modules filled with propellant, which would be used to keep the space station positioned properly in orbit. The new building would be able to accommodate testing, cleaning, and servicing of two to four modules simultaneously. The Kennedy Space Center was soliciting bids for construction of the plant, which was to be 70 feet high, 135 feet long and 65 feet wide. A contract, worth about \$11 million, was expected to be awarded in June 1992, with construction beginning in July, said payload projects manager JoAnn Morgan. (*Fla Today*, May 10/92)

- The Delta launch team at Cape Canaveral Air Force Station reported that the McDonnell Douglas Space Systems Company group was gearing up for two launches in the next 25 days. The first, a mission to deploy an Indonesian communications satellite, and the second, a mission during which NASA's Extreme Ultraviolet Explorer would be hurled into orbit, was scheduled for launch June 4, 1992. (*Fla Today*, May 10/92)

- Facing a tight budget, National Aerospace Plane officials proposed extra steps to slow the program aimed at building two runway-to-orbit research planes. The program's goal was to make the first flight of an X-30 aerospace plane by late 1999. The revised program director Robert Barthelemy presented the revised schedule to top Air Force and NASA officials in a quarterly technical review at NASA's Lewis Research Center in Cleveland. Congress approved \$250 million for the program for the 1992 year after slashing nearly \$100 million from the Bush administration's \$303.8 million request. (*Fla Today*, May 10/92)

- McDonnell Douglas Space Systems Company's Kennedy Space Center division was chosen as a finalist for the 1992 George M. Low Trophy, which is given annually to the NASA contractor which makes the greatest achievements in applying Total Quality Management (TQM) principles to their day-to-day operations. The goals of the award are to incorporate more efficient ways of doing business throughout NASA and its contractors and to transfer the performance improvement methods of award winners from company to company. "It is clear from your company's application that you have positive steps to advance quality, productivity and the continuous improvement

process," NASA Safety Chief George Rodney told division officials in a recent letter. (*Fla Today*, May 10/92)

May 11: A briefing and demonstration of a prototype low vision enhancement system (LVES), cooperatively developed by NASA and the Lions Vision Center at the Johns Hopkins Hospital, Baltimore, was scheduled to be held May 13 at the Oncology Center Auditorium. The LVES technology, originally developed for possible use on Space Station Freedom, potentially could help millions of Americans afflicted with certain low vision problems. (NASA Note N92-43)

May 12: NASA's Administrator Daniel S. Goldin said that NASA was involved in too many differing projects, and must zero in on which ventures to pursue and which to abandon. "NASA has a very broad range of things on its plate," said NASA Chief Daniel S. Goldin. "We don't have to do everything....If we can get more focused, we'll be much more efficient." (*USA Today*, May 12/92)

May 13: The *Wall Street Journal* reported that NASA officials had scheduled an unprecedented spacewalk by three Shuttle astronauts to rescue a satellite. The Agency decided to undertake the third and final three-man rescue attempt upon the request of Shuttle Endeavour's commander. (*WSJ*, May 13/92; *USA Today*, May 13/92; *W Post*, May 13/92; *W Times*, May 13/92; *NY Times*, May 13/92; *LA Times*, May 13/92; *P Inq*, May 13/92; *AP*, May 13/92; *UPI*, May 13/92)

May 14: NASA joined Auburn University in co-sponsoring the 1992 National Science Olympiad to be held at the Auburn, Alabama, campus. More than 1,500 of the Nation's top junior and senior high school students were to compete in the 33-event Olympiad, the largest science event in the United States. (NASA Release 92-66)

May 15: Scientists at NASA's Ames Research Center, Moffett Field, California, were investigating the importance of gravity to life on Earth. They also were studying whether intermittent exposure to gravity might help keep future space explorers healthy. Volunteers were confined to their beds for 24-hours a day in the head-down position to induce the physical changes associated with exposure to the microgravity of space. Results of the study indicated that these volunteers could avoid the changes simply by standing quietly for 15 minutes of each hour over a 16-hour period. Standing for two hours a day or walking at three miles per hour were almost as effective, according to Dr. Joan Vernikos, the study's principal investigator and acting chief of Ames' Life Science Division. (NASA Release 92-67)

- A spokesman for the International Telecommunications Satellite organization said a 23,000-pound rocket motor clamped to the marooned

Intelsat 6 satellite by the crew of Space Shuttle Endeavour fired flawlessly at 1:25 p.m. EDT while both were orbiting about 230 miles over Africa. The 122-nation consortium, based in Washington, owns and operates the \$150-million satellite. (*LA Times*, May 15/92)

- Astronaut Kathryn Thornton became the second woman to walk in space when she floated into the open cargo bay of Endeavour and tested techniques for building a Space Station. Thornton was accompanied by Thomas Akers, one of three men who had captured a wayward satellite the day before. (*C Trib*, May 15/92)

- Three American astronauts took a historic spacewalk using their gloved hands to make a last-ditch rescue of a wayward satellite. It was the first time so many astronauts had gone forth into space together and the first time anyone had captured an orbiting satellite with nothing but their hands. All previous salvage operations had mainly used some type of high-technology hardware. At 230 miles above the Earth, the three astronauts of the Space Shuttle Endeavour grabbed the wobbling 4.5 ton, 17 foot satellite and stopped its rotation, holding it motionless for about a minute while sloshing fuel settled down. (*NY Times*, May 14/92; *B Sun*, May 14/92; *USA Today*, May 14/92; *W Times*, May 14/92; *W Post*, May 14/92; *P Inq*, May 14/92; *AP*, May 14/92)

May 17: State Senator Gary K. Hart of California authored a bill which would require the Department of Commerce to create a special program for assisting commercial space ventures that originate in California. Under the proposal, the Commerce Department would boost California as the place to launch commercial space ventures. (*LA Times*, May 17/92)

- Space Shuttle Endeavour touched down on Rogers Dry Lake, California, ending a historic, nine-day maiden voyage. The public's response to Endeavour's mission, which featured an unprecedented three-astronaut capture of a stranded communications satellite, was the most enthusiastic since the Shuttle program resumed in 1988, NASA officials said. A crowd of an estimated 125,000 turned out in the desert to watch the landing. (*LA Times*, May 17/92; *P Inq*, May 17/92; *AP*, May 16/92; *W Times*, May 17/92; *B Sun*, May 16/92; *W Post*, May 17/92)

May 18: A company spokesman for Rockwell Corporation said that NASA was negotiating with Rockwell to build spare parts in the Antelope Valley for the Space Shuttle program. Rockwell was negotiating the terms of a \$55 million contract to build a midbody fuselage and a tail for the Space Shuttle fleet. The work would be performed in the hanger where the company built all of the Space Shuttles for NASA. Work would begin with 70 employees and is expected to last until 1999. (*Daily News*, May 18/92)

- *USA Today* reported that a video headset would soon allow people with limited vision to see their world as if projected on a 60-inch black-and-white TV

screen. The portable, 16-ounce Low Vision Enhancement System (LVES) should be commercially available in three years at a cost of \$3,000. It should help many of the three million people with visual impairments due to diseases such as diabetes, glaucoma, multiple sclerosis, and macular degeneration. (*USA Today*, May 18/92)

- The commander of the Space Shuttle Endeavour, Capt. Daniel C. Brandenstein of the Navy, said that the problems and needs of America's cities were no reason to divert money from the space agency's annual budget of \$14 billion. If anything, Captain Brandenstein said a strong space program was needed to inspire young people to high achievement and hopes for the future. He said that voyages of exploration were a vital social investment, today and centuries ago. "America is a country based on boldness and looking into the future, not looking out the back of the bus," said Captain Brandenstein. (*NY Times*, May 18/92)

- It was announced that the staff director of the National Space Council, the Cabinet-level agency that sets the Nation's space policy, was stepping down after a three-year tenure marked by calls for better management at NASA and a push for smaller, less-expensive space projects. Mark J. Albrecht, 41, who was a national security aide to then-Senator Pete Wilson, was widely viewed as one of the principal architects of the council's efforts to curb the appetite of NASA for more long-range, expensive space endeavours. Albrecht declined to discuss his plans, but some council members said that he would join a private consulting firm. (*LA Times*, May 18/92; *B Sun*, May 18/02)

May 19: NASA reported that astronaut Bruce E. Melnick, Commander USCG, will be leaving NASA in July 1992. Melnick, who flew on Space Shuttle missions STS-41 and STS-49, accepted the position of Director, Shuttle Processing Contract Process Improvement Technology with Lockheed Space Operations Co. (LSOC) at Kennedy Space Center, Florida. (NASA Release 92-68; *USA Today*, May 20/92; AP, May 19/92)

- Scientists at NASA's Goddard Institute for Space Studies said chemicals, particularly sulfurs, spewed into the atmosphere by the eruption of Mount Pinatubo in the Philippines are reflecting two percent of sunlight back into space, reducing heat. The impact is global; local temperatures might not be affected. Scientists said early studies of the effects of Pinatubo's eruption indicated volcanoes play a far greater role in climate change than once thought. (*USA Today*, May 19/92; *W Times*, May 19/92; *W Post*, May 19/92; *P Inq*, May 19/92; *B Sun*, May 19/92)

- The Washington Post reported that Mark J. Albrecht was leaving his post as executive secretary of the National Space Council. Albrecht's successor will be Brian D. Dailey, a Republican staff member of the Senate Armed

Services Committee. Albrecht said he had taken a job with the Washington area office of Science Applications International Corporation as a senior manager. (*W Post*, May 19/92)

May 21: U.S. scientists solved a 20-year-old mystery about the nature of Geminga, one of the brightest emitters of high-energy gamma rays in the sky. Using data from two different spacecraft, scientists now know that the power plant in Geminga is a rotating, 300,000-year-old neutron star. Dr. Jules Halpern of Columbia University and Dr. Stephen Holt of NASA's Goddard Space Flight Center reported that they had observed x-ray pulsations from Geminga using data from the German/American Roentgen Satellite (ROSAT). These observations firmly establish Geminga as a close cousin of the Crab and Vela nebulae, which also have pulsating neutron stars at their cores. The rotating neutron star produces focused beams of radiation much like the periodic flashing or pulsating lighthouse beacon. (NASA Release 92-69)

- India launched a research satellite into orbit using local technology in what officials called an important milestone in the country's ambitious space program. The 750-foot rocket blasted off from an island off the southern state of Andhra Pradesh. Nine minutes into the flight, the \$7 million rocket propelled a research satellite into orbit 280 miles above Earth. The flight was pronounced a total success. (*W Times*, May 21/92)

May 22: NASA Administrator Daniel S. Goldin announced the appointment of Bill Livingstone as Special Assistant to the Administrator for Communications. (NASA Release 92-71)

- A newspaper reported that three NASA aquanauts submerged since May 6, 1992, in a research station 30 feet below the surface of Emerald Lagoon, Florida were doing well but missed sunshine and their family members. The exercise was part of preparation for months-long stays aboard Space Station Freedom. (*USA Today*, May 22/92)

May 24: It was reported that astronomers had discovered expanding "bubbles" of hot hydrogen gas in dwarf galaxies that apparently are caused by the explosions of hundreds of stars collectively blowing matter completely out of the small galaxies. The discovery suggests that some galaxies are dying and tends to confirm conventional theories about star formation. The discovery was based on recent observations at the Very Large Array Radio Telescope (VLA). (*W Times*, May 24/92; *NY Times*, May 24/92)

May 26: NASA announced that Laurie A. Broedling had been appointed as Associate Administrator for Continuous Improvement. She would report directly to the Administrator and serve as NASA's primary facilitator of Total Quality Management. "This appointment is an important step in bringing a

world-class TQM program to NASA,” Administrator Daniel S. Goldin said. (NASA Release 92-72)

- NASA Administrator Daniel S. Goldin announced that his agency had started an intense examination of itself and its programs aimed at setting goals for the Nation’s civilian space program and controlling costs in the future. Goldin said he had named two teams to undertake an agencywide analysis of what NASA should be doing and what it could do within the constraints of a limited budget. The self-analysis was organized, Goldin said, after he examined the NASA budgets for the coming years and realized that the agency was committed to programs that could not be funded in an era of tight Federal spending. (AP, May 26/92)

- Scientists now believe that all the visible stars and galaxies account for less than one percent of the mass of the universe, with the rest being some kind of invisible, or dark matter. Finding the “stuff” of this hidden mass could alter theories of particle physics and would be a major step in understanding the structure and evolution of the universe. It might also enable cosmologists to predict whether the universe is destined to continue expanding forever or eventually to collapse of its own gravity. If dark matter does exist, and most of it turns out to be unlike the ordinary atoms of stars and people, the philosophical implications would be profound and humbling. Dr. Bernard Sadoulet, a physicist at the University of California and a leader of the search for dark matter, said: “It will be the ultimate Copernican revolution. Not only would we not be at the center of the universe as we know it, but we wouldn’t even made up of the same stuff as most of the universe.” (NY Times, May 26/92)

- After hearing complaints from employees across the nation, NASA Administrator Daniel S. Goldin unexpectedly announced he was changing the Agency’s logo. Goldin killed the despised “worm,” which displayed “NASA” in high-tech red lettering, and restored the insignia affectionately known as the “meatball.” The meatball, which served the agency from 1959 to 1975, consists of the agency’s name surrounding a starry blue background, a red wing shape and the flight path of a spaceship. It was worn by astronauts on Mercury, Gemini, and Apollo missions. (W Post, May 26/92)

- NASA launched a rocket from Puerto Rico’s north coast at 7:55 p.m. EDT to study radio waves in the ionosphere. The launch, originally set for May 18 but delayed due to bad weather, was the first time NASA had launched from the Caribbean island since 1967. (USA Today, May 26/92; AP, May 26/92)

- A team of scientists using two satellites in orbit announced they had solved the puzzle of a mysterious source of high-energy gamma rays, located in the direction of the constellation Gemini and known as Geminga. According to a report in the journal *Nature*, the gamma rays were flowing from a spinning 300,000 year old neutron star or pulsar. Scientists do not understand why

Geminga favors gamma rays over other wavelengths. Two other bright sources of gamma rays already known to be pulsars, buried within the Crab and Vela supernova remnants, emit radiation in x-ray, radio, and optical wavelengths. (*W Post*, May 26/92; *P Inq*, May 22/92)

May 27: Three U.S. scientists, including one from NASA's Ames Research Center, completed the first joint U.S./Russian Antarctic expedition since the breakup of the former Soviet Union. The purpose of the expedition was to investigate the physical, chemical, and biological properties of ice-covered lakes in the Bunger Hills Oasis of East Antarctica. This was the first time U.S. scientists had explored these lakes, which are near a Russian research station. (NASA Release 92-73)

- Nearly 300 atmospheric researchers were scheduled convene to study the effect of clouds on global climate in an international cooperative experiment. With NASA as the coordinating agency, scientists from over 50 research institutions in the United States and seven other countries would employ the combined measurements from land, sea, air, and space platforms. The project was to be based in the Azores and Madeira Islands of the eastern Atlantic Ocean. (NASA Release 92-74)

- NASA announced that an exotic mix of materials and equipment would be exposed to the unique conditions of microgravity during Space Shuttle Columbia's 13-day mission scheduled for June 1992. The flight would be NASA's longest Shuttle mission and was the first of a series of missions leading to 90-day assignments aboard the planned Space Station Freedom. Astronaut Bonnie Dunbar and three scientists were scheduled to spend most of their time in the pressurized Spacelab module in Columbia's cargo bay. (*USA Today*, May 27/92)

May 28: NASA announced that it would kick-off a nationwide tour of its full-scale traveling Space Station Freedom model in the Washington, DC, metropolitan area. The model, which is housed in two connected tractor trailers, features the U.S. living quarters and the U.S. laboratory module of the international space-based research facility. (NASA Note N92-47)

- Large landslides have been identified on Venus by Magellan Project scientists at NASA's Jet Propulsion Laboratory, Pasadena, California. They are similar to landslides that have been known for some time to occur on Earth and Mars, a project spokesman said. (NASA Release 92-75)

May 29: NASA announced that astronaut James F. Buchli (Col., USMC), a veteran of four Space Shuttle missions, was to retire from the U.S. Marine Corps and leave NASA to accept the position of manager, Station Systems Operations and Requirements with Boeing Defense and Space Group, Huntsville, Alabama. (NASA Release: 92-77)

- Associated Press announced that Hughes Aircraft and Japan's JVC together plan to build projection displays that would allow airline passengers to watch movies with the window shades up, and teleconferences to be held in rooms with the lights on. The basic technology, known as liquid crystal light valve projection, will allow projection of very bright, high-resolution images. The joint venture was to be based in Carlsbad, California, and employ about 200 people by the end of next year. (NASA Current News 92-107)

May 30: Advanced techniques used to place criminals are now being employed in NASA's continuing investigation of microbial activity in the weightless environment of orbiting spacecraft. Since the Apollo program, medical researchers have investigated the possibility of microbial cross-contamination between astronauts confined to a spacecraft. The advent of recent methods such as DNA fingerprinting, which studies organisms at the molecular level, has allowed scientists to track the transfer of a specific microbe within the environment of the Space Shuttle orbiter, according to a joint study by NASA's Johnson Space Center and the University of Texas Medical School. (NASA Release 92-79)

June

June 2: NASA reported that the TOPEX/Poseidon satellite would be launched aboard an Ariane IV launch vehicle from the Guiana Space Center (CSG) in Kourou, French Guiana. The satellite, a joint program of NASA and the Centre Nationale d'Études Spatiales, the French space agency, was to study ocean circulation and its role in regulating the global climate. (NASA Note N92-50)

- NASA's Hubble Space Telescope (HST) revealed a new class of object in the universe—a grouping of gigantic star clusters produced by the collision of galaxies. Images of the core of the peculiar galaxy Arp 220 show that stars are produced at a furious rate from the dust and gas supplied by the interaction of two galaxies. The discovery was made by Dr. Edward Shaya and graduate student Dan Dowling, University of Maryland, and the Wide Field/Planetary Camera Team. (NASA Release 92-80)

June 9: NASA Headquarters announced that Space Shuttle Columbia would be launched on a 13-day mission on June 25, 1992. Mission STS-50, planned to be the longest flight to date in the Shuttle program, will carry the United States Microgravity Laboratory-1 payload into orbit. A Spacelab long module was to serve as an in-orbit laboratory for seven crewmembers and 31 experiments devoted to material science, fluid physics, combustion science, and biotechnology. (NASA STS-50 Launch Advisory)

- NASA engineers were preparing to do the first assembly of a large-scale, parabolic antenna in a huge water tank whose buoyancy lets researchers simulate working in the microgravity environment of space. The tests would help establish assembly times for such antennas, evaluate work procedures and task coordination, and check the compatibility of the hardware itself. (NASA Release 92-84)

June 10: NASA Associate Administrator for Space Flight Jeremiah W. Pearson, III, announced that Thomas Utsman, Deputy Associate Administrator, Office of Space Flight, will become the Program Director for the Space Shuttle. He will direct long-range Shuttle planning, Space Shuttle continuous improvement activities, and efforts to reduce Shuttle operations costs while maintaining safety. (NASA Release 92-83)

- Through a letter agreement, NASA and the National Center for Manufacturing Sciences, Inc. (NCMS), Ann Arbor, Michigan, have established a continuing program for technology development and transfer between NASA, NCMS, and its member companies to advance the state of U.S. manufacturing. NASA and NCMS agreed to establish procedures and

principles for research endeavors in the area of advanced manufacturing sciences. (NASA Release 92-85)

- A 50-foot-long X-30 National Aerospace Plane (NASP) mockup rolled out of its hanger in ceremonies at Mississippi State University, Starkville. Forty-five students in Mississippi State's engineering program worked for five months to construct the 5,000-pound mockup at the University's Rasper Flight Research Laboratory. Throughout the project, they had access to NASP program officials, who advised them on technical aspects of the X-30's design. The program was directed by Dr. George Bennett. (NASA Release 92-86)

June 11: Two astronauts at NASA's Jet Propulsion Laboratory, Pasadena, California, said that they had evidence of planets or other bodies around eight stars they had studied in a star-forming region of the Milky Way Galaxy, 450 light years from Earth. The scientists, Drs. Kenneth Marsh and Michael J. Mahoney, said their discovery of unseen companions around low-mass stars in the Taurus-Auriga region of the Milky Way had resulted from the study of data from the Infrared Astronomy Satellite acquired in 1983 and data from ground-based observations acquired mostly from 1981-1983. (NASA Release 92-87)

June 15: Dr. Harriett G. Jenkins, Assistant Administrator for Equal Opportunity Programs, resigned her NASA position to become first director of the newly established Office of Senate Fair Employment Practices. (NASA Release 92-89)

June 18: NASA Administrator Daniel S. Goldin and Yuri Koptev, the director general of the Russian Space Agency, ratified the first contract between NASA and a Russian aerospace firm, NPO-Energia. The contract was for the study of applications of Russian space technology to the Space Station Freedom program. The contract was for an initial period of one year with a value of \$1 million. (NASA Release 92-91)

June 24: In remarks before the National Space Club, NASA Administrator Daniel S. Goldin said that the United States needs a laboratory in space so scientists can learn how to protect the health of humans living and working for long periods in space and improve the quality of life on Earth. "We can light up the sky with the inspirational work of Space Station Freedom, or we can stand by and watch the greatest technological bonfire of the century if it's canceled. We need Space Station Freedom and we need it now," said Goldin. (NASA Release 92-92)

- Robotics engineers and scientists at NASA's Jet Propulsion Laboratory (JPL), Pasadena, California, planned to demonstrate a new planetary lander and robotic rover at a specially designed test site near the laboratory. "Rocky IV," a prototype of a mini-rover, might be launched to Mars in 1996 as part of

the Mars Environmental Survey (MESUR) Pathfinder mission. The 16.5-pound testbed would let NASA researchers study how to integrate planetary lander functions and science instruments under conditions approximate to those of a Mars mission. (NASA Release 92-93)

- NASA Administrator Daniel S. Goldin announced the appointment of key personnel in the Office of Public Affairs and the Office of Equal Opportunity Programs. Bill Livingstone was appointed Associate Administrator for Public Affairs; Sue Mathis Richard was appointed Deputy Associate Administrator for Public Affairs; Lewin S. Warren was appointed acting Assistant Administrator for Equal Opportunity Programs; and Oceola S. Hall was designated acting Deputy Assistant Administrator for Equal Opportunity Programs. (NASA Release 92-94)

June 25: It was announced that astronaut John O. Creighton (Capt., USN) would retire from the U.S. Navy and leave NASA to work in the Commercial Airplane Group of the Boeing Co., Seattle, Washington, beginning September 1, 1992. He was to work as a production test pilot and as an instructor pilot in the customer support area. (NASA Release 92-96)

June 29: Using NASA's Hubble Space Telescope (HST), an international team of astronomers took a major step in redetermining the expansion rate of the universe. This rate, known as the Hubble Constant, is one of two critical numbers needed for making a precise determination of the size and age of the universe. The Constant is an estimate of the rate at which the universe is expanding and is expressed in kilometers per second per megaparsec (3.26 million light years). The results were reported by Drs. F. Duccio Macchetto, Nino Panagia, and Abhijit Saha of the Space Telescope Science Institute, Baltimore, Maryland; Allan Sandage of the Carnegie Institution of Washington; and Gustav Tammann of the University of Basel, Switzerland, at the international workshop "Science with the Hubble Space Telescope," held in Sardinia, Italy, June 29 through July 9, 1992. (NASA Release 92-97)

- NASA reported that a survey of the heavens with the Hubble Space Telescope (HST) was uncovering remote and unusual galaxies never before resolved by optical telescopes on Earth. HST revealed an unusual variety of shapes and structures in these distant galaxies, which previously had appeared as fuzzy blobs in ground-based sky surveys. The results might lead to much clearer understanding of the formation and evolution of galaxies. The results were presented by Dr. Richard Griffiths of the Space Telescope Science Institute, Baltimore, Maryland. (NASA Release 92-98)

June 30: NASA Administrator Daniel S. Goldin signed an agreement with International Technology Underwriters (INTEC) to explore ways that the insurance industry can assist in financing human and robotic satellite rescue

and repair missions. INTEC would also look at options for providing incentives in the construction of commercial satellites to make them easier to rescue and repair if problems develop. "We need to consider new approaches to salvaging satellites that will encourage the further commercialization of space, such as robotic rescues in high and lower orbits," Goldin said. (NASA Release 92-99)

July

July 1: NASA announced the departure of Navy Capt. Daniel C. Brandenstein, chief of the Astronaut Office, Johnson Space Center, Houston, since 1986 and a veteran of four Space Shuttle missions, effective about October 1. Selected by NASA in 1978, Brandenstein first flew as a pilot aboard the Shuttle Challenger in 1978 and holds the record for time in space (789 hours) among Space Shuttle astronauts. (NASA Release 92-100)

- Newly-released photographs from the Hubble Space Telescope showed that the “Whirlpool Galaxy” may have a black hole at its core and that the core of a powerful infrared radiating galaxy called Arp 220 supports vigorous star birth and supernova star explosions. Astronomers suspect that Arp 220 is the product of an earlier collision of two “parent” galaxies. (CSM, Jul 1/92)

- Cornell University astrophysicist Thomas Gold said in the “Proceedings of the National Academy of Sciences” that there is probably more life inside the Earth than there is on its surface. This life would be in the form of bacteria and other microorganisms, and its overall volume probably surpasses that of all the plants and animals living on the planet’s surface. NASA scientist Stephen Maran said that if Gold’s ideas prove correct, “they will revolutionize scientific theories of geology and the evolution of life on Earth.” Gold speculated that similar life forms may exist inside the Moon and other planets in our solar system. “The surface life on Earth, based on photosynthesis for its overall energy supply, may be just one strange branch of life. The deep, chemically supplied life, however, may be very common in the universe,” Gold commented. (*P Inq*, Jul 1/92)

- Scientists studying data from the Magellan radar-mapping satellite around Venus concluded that Venus is not a twin of the Earth. Magellan has produced images 10 times sharper than any seen before of more than 97 percent of the planet’s surface. Magellan’s images show Venus to be as geologically active as the Earth, but whereas Earth’s crust is shaped by continuous recycling, Venus’ surface appears to evolve by building crust vertically as lava flows out of volcanoes or meteorite craters. (CSM, Jul 1/92)

- NASA chose Rockwell International’s Palmdale plant in California to refit the seven-year-old Space Shuttle Atlantis, allowing the spacecraft to stay aloft longer and possibly enabling it to rendezvous with the Russian Space Station Mir. (*LA Times*, Jul 2/92)

- The Kennedy Space Center awarded three indefinite-delivery, indefinite-quantity contracts for its Personal Computer Acquisition contract program. The three winners were to provide a range of personal computers, peripherals,

and software packages and would be required to compete against each other for NASA orders throughout the duration of the contract, an arrangement designed to provide NASA with the most up-to-date equipment at the lowest cost. (*Federal Computer Week*, July 13/92)

July 3: NASA launched the first of its new, low-cost spacecraft, the Solar, Anomalous, and Magnetospheric Particle Explorer satellite (SAMPEX) aboard a four-stage Scout rocket from Vandenberg Air Force Base, California. The spacecraft was designed to study anomalous cosmic rays in an effort to improve understanding of the evolution of the Sun, the solar system, and the Milky Way Galaxy. (NASA Release 29-102; *The Sun*, Jul 4/92; *P Inq*, Jul 4/92; *W Times*, Jul 4/92; *W Post*, Jul 4/92; *LA Times*, Jul 5/92; *NY Times*, Jul 5/92)

- Space Shuttle Columbia Commander Richard N. Richards made a pitch today for the Space Station Freedom, saying that astronauts on the Columbia Shuttle flight needed more time in orbit to conduct scheduled experiments. Such time would be available on the Space Station, which had experienced funding difficulties in Congress. Two Shuttle astronauts worked through part of their breaks as they rushed to complete experiments, one dealing with the growth of crystals and the other with dust particles. (*W Post*, Jul 4/92)

July 4: Astronauts aboard the Shuttle Columbia beamed down Fourth of July greetings on the 10th day of a planned 13-day mission, the longest in Shuttle history. The goal of Columbia's was twofold: to study the effects of weightlessness on physical, chemical, medical, and biological processes, and to demonstrate the Shuttle's capability to remain in orbit at least 13 days. A wide range of experiments aimed at generating knowledge from microgravity science were underway in the long Spacelab module being flown on Columbia. (*UPI*, Jul 4/92; *AP*, Jul 4/92; *LA Times*, Jul 5/92; *W Post*, Jul 5/92; *NY Times*, Jul 5/92; *P Inq*, Jul 5/92; *W Times*, Jul 5/92; *Reuters*, Jul 4/92; *AvWk*, Jul 6/92)

July 6: The Space Shuttle Columbia and its crew set a record for the longest Space Shuttle flight on the 11th day of a laboratory research mission. Columbia passed the previous Shuttle endurance record of 10 days, 21 hours, and one minute set in 1990 by another Shuttle Columbia crew. (*W Times*, Jul 7/92; *The Sun*, Jul 7/92; *W Post*, Jul 7/92; *AP* Jul 7/92; *UPI* Jul 7/92; *USA Today*, Jul 7/92)

- Scientists announced that dust and chemicals from last year's eruption of Mount Pinatubo in the Philippine Islands had cooled the Earth by blocking incoming sunlight. The planet's average temperature dipped about one degree between the June 16, 1991, eruption and May of this year because a layer of sulfuric acid droplets released by the volcano had reduced the total amount of solar energy reaching the Earth's surface. The scientists said the cooling should last about five years. (*W Times*, Jul 7/92; *AP*, Jul 7/92)

- Engineers from Stanford University announced that they had teamed up with Russian space exploration experts to define an international manned mission to Mars that would cost about \$70 billion, a relative bargain compared with NASA's estimates of a U. S.-only mission. Significant contributions from the European Space Agency and Japan were also included in the plan, which envisioned sending six astronauts to Mars for a 500-day visit in 2009. The plan relied on readily available space technology and would not require major new appropriations from Congress. (*AvWk*, Jul 67/92)

July 7: NASA Administrator Daniel S. Goldin announced the appointment of Samuel W. Keller as Associate Administrator for Russian Programs. The new position was established to provide focus for the many programs involving NASA and the former Soviet Union. (NASA Release 92-103)

- NASA ground controllers said they had reactivated two key scientific instruments aboard the Upper Atmosphere Research Satellite and hoped to revive the other eight in coming weeks following two major glitches with the motors that drive the solar power array. The problems had sent the satellite into a quiescent safe mode June 1 and 2. The Microwave Limb Sounder, which helps measure ozone depletion, and the Cryogenic Limb Array Etalon Spectrometer, which has a limited lifetime, were restored to service. (*Space News*, Jul 7/92)

July 8: Weather conditions forced postponement of the Space Shuttle Columbia's return, lengthening what is already NASA's longest Shuttle mission into a full two weeks. (*P Inq*, Jul 9/92; *LA Times*, Jul 9/92; *W Post*, Jul 9/92; *NY Times*, Jul 9/92; *W Times*, Jul 9/92; *The Sun*, Jul 9/92)

- Russian cosmonauts Alexander Viktorenko and Alexander Kalery worked outside the Mir Space Station on an unscheduled two-hour spacewalk to activate a pair of gyroscopes that help stabilize the Space Station. The gyroscopes had worn out naturally during the course of Mir's life and had to be replaced. (AP Jul 8/92)

- A spokesman announced that NASA had failed in its latest attempt to fix the jammed main antenna on the Jupiter-bound Galileo spacecraft, but the Agency said it would try different repair methods next year. Engineers turned Galileo's main antenna toward the Sun to warm it, then cooled it in shade, but the antenna remained stuck. The latest warming and cooling of the antenna was the seventh and final effort to open the antenna by thermally expanding or shrinking what NASA engineers think are stuck pins on three of the antenna's ribs. Despite the loss of the main antenna, NASA scientists expected to complete 70 percent of Galileo's mission by using a small antenna. The small antenna, however, is capable of transmitting only one percent as many computer "bits" as the main antenna would have sent. (AP, Jul 8/92)

July 9: To help bolster the competitiveness of American industry, NASA and the Department of Energy announced that they had formed a partnership to enhance the transfer of technologies developed in their laboratories to American enterprise. Areas of cooperation included outreach to business and non-profit research organizations, access to Federal technology resources, training and education, dissemination of scientific and technical information, and technology transfer policy and program analysis.

The two agencies also signed a cooperative agreement on energy-related civil space programs. The agreement provided overall principles that outlined the responsibilities and authority of both NASA and the Department of Energy in research and development, fundamental science, advanced technology development, and education efforts. (NASA Releases 92-104 and 92-107)

- The Space Shuttle Columbia landed at the Kennedy Space Center in Florida at the conclusion of the longest-ever Shuttle flight, a 14-day research mission intended as a rehearsal for NASA's Space Station. The arrival was diverted from the preferred site, Edwards Air Force Base in California, because of rain. (*P Inq*, Jul 10/92; *The Sun*, Jul 10/92; *LA Times*, Jul 10/92; *W Times*, Jul 10/92; *W Post*, Jul 9/92, 10/92; *CSM*, Jul 10/92; *NY Times*, Jul 10/92; *WSJ*, Jul 10/92; *AP*, Jul 09/92; *UPI*, Jul 9/92)

- NASA researchers said they had "flown" a complete three-dimensional high-performance aircraft in a supercomputer for the first time. The research was part of an effort to reduce wind tunnel tests of new aircraft designs. The new supercomputer techniques have promise in aerodynamic studies of fighter aircraft and in other areas where fluid flow is modeled, such as weather prediction, spacecraft entry, artificial heart design, etc. (NASA Release 92-105)

- NASA Administrator Daniel S. Goldin and National Space Council Executive Secretary Brian Dailey left with an interagency delegation to visit the European Space Operations Center in Germany. The delegation planned to proceed on to Moscow to gain a first-hand understanding of Russia's space program. (NASA Release 92-106)

- In a letter to the British journal *Nature*, two American scientists at the University of Arizona's Lunar and Planetary Laboratory, David Kring and William Boynton, said that they had found what they believe to be the location where a gigantic object from outer space crashed into the Earth 65 million years ago, possibly ending the age of the dinosaurs. The site is a buried crater 110 miles across on the Yucatan Peninsula in Mexico. (*The Sun*, Jul 9/92; *WSJ*, Jul 9/92)

- In another article in *Nature*, scientists from NASA and Hughes STX Corporation in Lanham, Maryland, said that the uppermost part of Earth's

protective ozone layer was about seven percent thinner in 1989 than it was in 1980. The conclusions were based on observations taken by the Nimbus-7 environmental research satellite launched in 1978 and refined by a calibration device on a Space Shuttle mission in October 1989. The new observations were consistent with previous projections of ozone depletion. (*UPI* Jul 9/92;

- NASA announced that it expected to launch a radar satellite in August that would sweep above the Bering Sea off Alaska and beam down a detailed radar snapshot giving the location of every fishing vessel. The project was intended to be the beginning of a foolproof system to police the world's fishing grounds against pirate trawlers. NASA expected to spend \$650,000 as its share of a program to transfer its sophisticated technology to commercial uses. (*P Inq*, Jul 9/92)

July 10: Writing in the *Astrophysical Journal*, two astronomers at the University of Hawaii discussed evidence of a monstrous black hole with the mass of a billion suns, 100 times more powerful than any apparent black hole previously detected. The suspected black hole at the center of NGC 3115, a galaxy 30 million light-years away, appears to be about half as large as our solar system. The discovery moves the concept of black holes further along from theoretical prediction to accepted reality. It also illuminates the nature of the mysterious, brilliant objects known as quasars. (*LA Times*, Jul 10/92; *W Post*, Jul 10/92; *W Times*, Jul 10/92)

- The European Space Agency's Giotto space probe, which six years ago flew within 335 miles of Comet Halley, flew past Comet Grigg-Skjellerup. Although the probe's cameras were too badly damaged from the Halley fly-by to be used, Giotto's other instruments measured magnetic fields, dust impacts, electrically charged gases, and the chemical makeup of particles from a distance of 124 miles. (*AP*, Jul 7/92, Jul 11/92; *P Inq*, Jul 11/92)

- A recent U.S. Senate Committee on Governmental Affairs oversight subcommittee report said that millions of dollars had been wasted in recent years because of poor auditing and contract management at 39 federally funded research and development centers. The report concluded that standard government accounting and auditing requirements were often "missing or ignored" at the privately owned but publicly funded research centers, which together received contracts worth more than \$10 billion last year. Among the laboratories criticized was the Jet Propulsion Laboratory in Pasadena, California, which received \$1 billion in fiscal year 1990 funding from NASA. (*W Post*, Jul 10/92)

- NASA officials scheduled the next Shuttle launch for July 31, three weeks after the Shuttle Columbia returned from its record-breaking two-week mission. Atlantis' seven-day flight was slated to troll an Italian satellite on a 12-

mile-long tether and to launch Eureka, a European satellite, on a one-year mission. (*AP*, Jul 10/92, Jul 26/92; *W Times*, Jul 27/92; *NY Times*, Jul 28/92)

July 11: Harrison A. Storms, Jr., an aeronautics pioneer, died at his home in Rancho Palos Verdes, California, at age 76. Storms' designs and leadership played a key role in developing B-25 and P-51 Mustang fighters in World War II and in Project Apollo's billion-dollar race for the Moon in the 1960s. He served as an advisor to NASA, the Air Force, and the Pentagon. (*NY Times*, Jul 16/92)

July 12: The Pentagon announced that it would allocate \$1.5 billion for the V-22 Osprey to keep development of the aircraft alive through next year. The move temporarily settled a three-year battle between Defense Secretary Dick Cheney and a coalition of V-22 supporters in Congress and the military. (*USA Today*, Jul 13/92)

July 13: NASA started the first flight test in Denver of a laser-based sensor to provide airline pilots with advance warning of "microbursts" that can harbor potentially dangerous windshears. The Federal Aviation Administration has mandated that airlines must select and install an approved microburst detection system on their aircraft by the end of 1995. (NASA Release 92-108)

- Scientists from the United States and Australia announced completion of the Southern Ocean Waves Experiment. From June 6 through June 18, the scientists observed how ocean winds and waves affect one another off the coast of Australia. Project findings were expected to improve the reliability of ocean wave forecasting and to improve measurements from the TOPEX/Poseidon satellite. This satellite, a joint U.S./French venture, was scheduled for launch in August 1992 and was to study ocean topography and circulation, leading to better understanding of the oceans' role in global climate change. (NASA Release 92-109)

July 14: A NASA "aquanaut" set an endurance record of 69 days, 20 minutes underwater after spending time in a scuba divers' lodge submerged in a Florida Keys lagoon. Richard Presley began the habitation May 6 as part of an experiment by NASA on conditions astronauts would face during long space missions. (*W Times*, Jul 15/92; *USA Today* 15/92; *AP*, Jul 15/92)

- Engineers at the Jet Propulsion Laboratory said that the Magellan spacecraft, already threatened with suspension of operations to save money, had developed serious transmitter trouble and for more than a week had been unable to send usable data and pictures for the completion of its mapping survey of the Venusian surface. Magellan's only functioning radio transmitter begun overheating, a repeat of similar trouble more than a year ago. Engineers hoped to devise a solution within a few days. (*NY Times*, Jul 15/92; *NY Times*, Jul 18/92)

- NASA announced that Rockwell International Corporation's Space Systems Division had received NASA's first-ever award for World Class Performance in recognition of its exemplary work in building the new Space Shuttle orbiter Endeavour. The award is given when the NASA Administrator determines that an organization has performed world-class work of significant benefit to the Agency and U.S. taxpayers. (*PR Newswire*, Jul 14/92)

July 15: NASA said that construction had started on a high-flying, light-weight, unpiloted research aircraft called "Perseus" that NASA was to use to measure ozone levels and other atmospheric conditions. NASA viewed Perseus as the first step toward general use of advanced aircraft for many aspects of Earth sciences research such as climate and radiation studies, tropical dynamics, meteorology, and for studies of the stratosphere and troposphere. Aurora Flight Sciences Corporation of Manassas, Virginia, won the \$2.25 million contract to design, build, and flight test two Perseus aircraft. Flight tests were slated to begin in late 1992. (NASA Release 92-110)

- Solar scientists were puzzled by an unexpected "gamma ray afterglow" discovered on the Sun by NASA's Compton Gamma Ray Observatory. The glow, a strong emanation of high-energy gamma rays, persisted for more than five hours after a solar flare explosion on June 11, 1991. A similar phenomenon occurred four days later. The scientists also announced that the Compton Gamma Ray Observatory had taken the first image of the Sun in neutrons, the first picture of any celestial object ever made with neutrons, that is, matter, rather than light. Another scientist reported that the Hubble Space Telescope had found evidence of powerful beams of downward-streaming protons at the onset of a stellar flare while looking at a red dwarf star more than 30 light-years away. Solar flares can produce magnetic storms on Earth that interfere with electrical power and radio transmissions. (NASA Releases 92-112 and 92-113; *NY Times*, Jul 16/92; *USA Today*, Jul 16/92; *The Sun*, Jul 16/92; *P Inq*, Jul 16/92; *UPI*, Jul 15/92, Jul 17/92; *W Post*, Jul 20/92; *Space News*, Jul 27-Aug 9/92)

- A study conducted for the Federal Aviation Administration by the Metropolitan Washington Council of Governments concluded that the Washington area could support flights of "tiltrotor" aircraft to New York and Boston. Tiltrotors would be competitive with commercial aircraft within a range of about 350 nautical miles from Washington. To date, tiltrotor aircraft had been developed and flown by the military, which hoped to use the craft for transporting troops. (*W Post*, Jul 16/92)

- The "New York Times" reported that the Georgia Institute of Technology was engaged in experiments to measure the impact of sonic booms on people and buildings. The research was part of a NASA program to develop a supersonic commercial airplane larger and faster than the Concorde. (*NY Times*, Jul 15/92)

July 16: NASA announced that a group of Alaskans had started a three-year experiment in the use of a small emergency radio transmitter known as a Personal Locator Beacon to communicate with a 10-year-old search and rescue satellite system that up to now had been used primarily for aircraft and ship emergencies. The locator beacon has the potential to save lives when used in emergencies in remote areas. The experiment was being carried out by NASA, the National Oceanic and Atmospheric Administration, the U.S. Air Force, and the U.S. Coast Guard. (NASA Release 92-115)

- At a news conference in Moscow, NASA Administrator Daniel S. Goldin announced plans for the United States and Russia to implement the agreements Presidents Bush and Yeltsin announced on June 17, 1992. Goldin said significant progress was made in developing a plan to carry out a wide range of projects, including expansion of cooperation in life sciences and global change research, the exchange of an American astronaut and Russian cosmonaut, and a Space Shuttle rendezvous and docking with the Russian Mir Space Station. A tentative date of October 1993 was set for a cosmonaut on the Space Shuttle, with an American on the Russian Space Station Mir the next year. Goldin also signed a \$1 million contract with the Russian space agency for a detailed study of the use of Russian space technology in the U.S. space program. (NASA Release 92-116; UPI, Jul 17/92; WSJ, Jul 17/92; AP, Jul 16/92; W Post, Jul 20/92)

- The North American Air Defense Command said that it was tracking nearly 7,000 spacecraft and pieces of debris bigger than a square yard that were in orbit around the Earth. The proliferating use of satellites has resulted in a ring of several hundred of the spacecraft around the Earth's equator, most in low-Earth to mid-Earth orbit. As a result, concerns were being raised about possible interference from one satellite to another and about the need for adequate distance between satellites in view of plans for more satellites in the 1990s. (W Times, Jul 19/92)

July 20: NASA announced that the Upper Atmosphere Research Satellite (UARS) had resumed full science operations following the resolution of problems with the satellite's solar array drive. Flight controllers had turned off the satellite's instruments June 2 after observing that the solar array drive was not operating smoothly and that the solar array itself was not properly tracking the Sun. UARS was launched September 12, 1991, by the Space Shuttle Discovery. It was designed to study the chemistry, dynamics, and energetics of the Earth's upper atmosphere, focusing particularly on ozone depletion. UARS was the first major satellite element of NASA's Mission to Planet Earth. (NASA Release 92-117)

- A V-22 Osprey "tiltrotor" aircraft carrying seven people crashed into the Potomac River at the Quantico Marine Corps Air Station in northern Virginia, killing all seven passengers. The crash involved the fourth of five

prototype Ospreys built by the military since 1989. The craft was on its maiden flight from Florida when the crash occurred. (*W Post*, Jul 21/92; *NY Times*, Jul 21/92; *The Sun*, Jul 22/92)

- The seven astronauts who returned to Earth July 9 after spending 14 days on the Shuttle Columbia said that getting used to Earth again had been similar to adjusting after shorter flights. They also said that preliminary results indicated their experiments had been successful. The crew grew protein crystals for use in medical research, studied fire safety in space by lighting candles and igniting wiring insulation and polyurethane foam, jiggled drops of liquid with sound waves to see how fluids behave in space, and tested a new miniature space greenhouse. (*AP*, Jul 10/92, Jul 21/92)

July 21: NASA and the National Institutes of Health signed an agreement to enhance each agency's biomedical research capabilities. The agencies pledged to develop programs that apply NASA's unique expertise to practical, medical needs on Earth and in space. The agreement was intended to stimulate new opportunities in the biomedical and behavioral research community because it provides for greater access to space-based facilities as well as involvement by university-based research centers. It was expected to increase support for Space Station Freedom, funding for which was under attack in Congress. (NASA Release 92-119; *W Post*, Jul 22/92; *Space News*, Jul 27-Aug 9/92)

- A division of Rockwell International agreed to pay \$1.42 million and to permit the Federal government to lecture employees about honesty to settle a fraud case involving Space Shuttle work. Prosecutors said they would drop charges that Rockwell's Collins Commercial Avionics Division in Cedar Rapids, Iowa, which makes and repairs Shuttle flight instruments, had defrauded NASA by altering time cards for work done on the Shuttle program. (*P Inq*, Jul 22/92; *NY Times*, Jul 22/92; *WSJ*, Jul 22/92; *AP*, Jul 21/92)

July 22: NASA Administrator Daniel S. Goldin announced the expansion of the National Space Grant College and Fellowship Program to include all 50 states and the District of Columbia. The Space Grant Program offers states the opportunity to receive grants to further projects in aeronautics, space, and related fields. (NASA Release 92-112)

- Vice President Dan Quayle called for a major review of the Nation's space policies that could lead to formal merger of some civilian and military activities for the first time since the Space Age began. Quayle essentially suggested that the National space agency consider increasing the interaction between civil and national security space activities, lowering some of the technical and managerial walls, a process already occurring on an ad hoc basis, analysts said. (*W Post*, Jul 23/92)

July 24: NASA Administrator Daniel S. Goldin announced a series of procurement reforms to make NASA the model of excellence for the Federal government. Goldin said reforms in NASA's procurement process were necessary because 90 percent of the Agency's budget is spent through contracts. Major changes in procurement will include the award of new contracts to companies that have demonstrated accountability by delivering quality systems that meet cost, schedule, and technical requirements. (NASA Release 92-123)

- According to NASA scientists, human, plant, and animal cells exposed to the microgravity of space for only a few days show changes in function and structure. Although preliminary, the results of the recent life sciences research on the Space Shuttle suggest alteration in metabolism, immune cell function, cell division, and cell attachment. Scientists also reported dramatic changes from space travel in some of the body's systems. Four principal investigators from the Space Life Sciences-1 mission flown aboard Space Shuttle Columbia in June 1991 reported key finds in the areas of cardiovascular, musculoskeletal, and neurovestibular physiology. (NASA Release 92-124)

- NASA launched a rocket carrying a Japanese scientific satellite called "Geotail" that will swing by the Moon and be flung by lunar gravity nearly a million miles into space. The satellite was intended to explore the effect of the solar wind on the tail of the magnetosphere, a comet-shaped region surrounding Earth and containing radiation belts. The \$160 million, four-year mission was a joint project between NASA and the Japanese Institute for Space and Astronautical Science. (*W Post*, Jul 25/92; *APn*, Jul 24/92)

- NASA researchers said that tests on astronauts aboard a June 5-14, 1991, flight of the Space Shuttle Columbia found their hearts, lungs, immune systems, and nervous systems responded in unexpected ways. Involved were blood pressure, muscle mass, production of key cells, and proper balance and orientation. The results do not suggest any major obstacles to long-term space missions, according to Ronald White, NASA's chief of Life Sciences. Longer human space flights, however, might depend on developing artificial gravity or other measures to minimize the physical effects of spaceflight. (*UPI*, Jul 25/92; *NY Times*, Jul 25/92; *W Post*, Jul 25/92)

July 27: A joint Russian-French crew blasted off on a 12-day mission aimed at keeping the aging Space Station Mir in orbit until 1996. The cosmonauts were slated to install a complex of stabilizing gyroscopes inside the Station and also to work in space to assemble an engine to make space navigation easier. (*W Times*, Jul 22/92; *AP*, Jul 21/92, Jul 27/92; *UPI*, Jul 27/92; *The Sun*, Jul 28/92; *WSJ*, Jul 28/92; *W Post*, Jul 28/92; *NY Times*, July 28/92; *APn*, Jul 27/92; *UPn*, Jul 27/92)

- NASA engineers decided to stop operating the radar aboard the Magellan Venus mapping probe until early September in an attempt to preserve the

spacecraft's one fully operational transmitter until Magellan swings over one of the large regions of the planet that it has not mapped. Ground controllers had relied on Magellan's backup transmitter since January, but the backup unit had developed radio noise that interfered with its periodic transmissions of scientific data. (*Space News*, Jul 27-Aug 9/92)

- Recent findings by the Very Large Array radio telescope in New Mexico confirmed that the so-called "Great Annihilator," a mysterious region close to the center of the Milky Way galaxy that spews out bursts of high-energy gamma rays, does seem to be a black hole, but it is much smaller than thought and it is, indeed, merely close to, not at the center of, the galaxy. It seems also to be powered by collisions between matter and antimatter. (*Time*, Jul 27/92)

- NASA and air industry sources said recently that a decision to narrow the number of engine concepts for the U.S. high-speed civil transport would slip by about a year. Test facility startup delays and the failure of preliminary nozzle tests to allow early identification of a preferred noise suppression system were cited as the main reasons for the slip. Postponement of the decision was not expected to affect the pace of high-speed civil transport development or the program's long-term schedule, which could lead to an operable aircraft in 2005. (*AvWk*, Jul 27/92)

- Recent studies showed that the technology spinoffs from National Aero-Space Plane (NASP) research and development had already had a positive impact on U.S. aerospace, automotive, medical, chemical, food processing, and energy industries. The studies predicted that the Gross National Product could expand by about \$26 billion over the next 10-15 years as a result of productivity gains fostered by the program and that employment also could increase by an average of 40,000 jobs annually. In particular, the studies showed that NASP research could significantly benefit industries such as aerospace, motor vehicle, and emerging industries such as ceramics and high-speed civil transportation. (*AvWk*, Jul 27/92)

- Contractors were awaiting the award of the \$3 billion Earth Observing System Data and Information System (EOSDIS) contract, which had been expected in early July. The proposal had been undergoing review and evaluation, and several suggestions for increasing the utility of the system for global environmental change research were offered in the opening of the initial report. In March 1992, NASA projected EOSDIS spend about \$200 billion through the 1990s. (*Federal Computer Week*, Jul 27/92)

July 28: The Kennedy Space Center, Florida, said it had awarded first-of-a-kind contracts to three firms under NASA's Personal Computer Acquisition Contract program. Throughout the five-year life of the contracts, the three companies would have to compete against each other for NASA orders to

supply personal computer hardware and software to Kennedy Space Center and other NASA locations. NASA established this competitive arrangement so that the Agency could be assured of a steady supply of high-quality products for the best price. (NASA Release C92-10)

- The countdown began for the Space Shuttle Atlantis on a mission to test an Italian satellite linked to the Shuttle by 12 miles of electricity-generating cord. NASA officials said there was a 90 percent chance of acceptable launching conditions on July 31. (*NY Times*, Jul 29/92, Jul 31/92; *CSM*, Jul 29/92; *UPI*, Jul 29/92, Jul 30/92, Jul 31/92; *AP* Jul 29/92, Jul 30/92, Jul 31/92; *USA Today*, Jul 30/92, Jul 31/92; *The Sun*, Jul 31/92; *W Post*, Jul 31/92; *LA Times*, Jul 31/92; *P Inq*, Jul 31/92)

July 29: A Russian-French crew docked with the Space Station Mir during the first of several joint missions intended to strengthen both countries' space programs. While aboard Mir, the crew was scheduled to conduct several experiments, including one into the chemistry of urine and saliva in weightlessness. They also would test vibrations and pressure on the human body. (*AP*, Jul 29/92)

- The Space Station Freedom was saved, as the House of Representatives voted down an amendment aimed at killing the \$40 billion project. The House voted 237-181 against an appropriations bill amendment that would have cut \$1.2 billion from the 1993 budget for NASA, effectively eliminating the Space Station. The Station was expected to cost \$40 billion to build and \$100 billion more to operate over its lifetime. It was the fourth time in the last two years that the House had affirmed its commitment to build the Space Station. Supporters said the vote could well represent the program's last serious Congressional challenge. (*P Inq*, Jul 30/92; *LA Times*, Jul 30/92; *NY Times*, Jul 30/92; *WSJ*, Jul 30/92; *W Times*, Jul 30/92; *W Post*, Jul 30/92; *The Sun*, Jul 30/92; *USA Today*, Jul 30/92; *AP*, Jul 30/92; *UPI*, Jul 30/92; *Htsvl Tms*, Jul 30/92; *AvWk*, Aug 3/92)

July 30: A Senate Appropriations subcommittee recommended spending no additional funds for NASA's advanced solid-rocket motor plant in Mississippi. On July 29, the House of Representatives voted 249 to 159 to eliminate \$265 million in research and development funds for the project, leaving only \$50 million to close it down. (*W Post*, Jul 31/92; *Htsvl Tms*, Jul 30/92)

July 31: The Shuttle Atlantis rocketed into orbit on a seven-day mission carrying a science satellite that is to be left in space and another satellite that was to be reeled out 12 miles and back in a critical test of tethered space flight. Dr. Franco Malerba, an electrical engineer and Italy's first astronaut, was in charge of the tether operation. Another European, Dr. Claude Nicollier, a test pilot and research scientist from Switzerland, was to oversee the deploying of the European Space Agency's Eureca satellite, designed to investigate materials

processing and life sciences. The other crew members, all Americans, were Col. Loren J. Shriver of the Air Force, Maj. Andrew M. Allen of the Marine Corps, Marsha S. Ivins, Dr. Jeffrey A. Hoffman, and Dr. Franklin R. Chang-Diaz. (*NY Times*, Aug 1/92, Aug 2/92; *P Inq*, Aug 1/92; *The Sun*, Aug 1/92; *W Post*, Aug 1/92; *W Times*, Aug 1/92)

August

August 2: Astronauts aboard the Space Shuttle Atlantis released the European Space Agency's Eureka satellite, but it encountered immediate problems with its steering system and remained in too low an orbit. Engineers at the European Space Agency's control center in Darmstadt, Germany, struggled to understand the problem, hoping to boost the satellite into its proper orbit 320 miles above the Earth within a day or two. (*W Times*, Aug 3/92; *WSJ*, Aug 3/92; *The Sun*, Aug 3/92; *LA Times*, Aug 3/92; *NY Times*, Aug 3/92; *P Inq*, Aug 3/92; *APn*, Aug 3/92; *UPI*, Aug 3/92)

August 3: Technicians at the Kennedy Space Center in Florida placed the Mars Observer spacecraft atop its upper-stage rocket in preparation for launch sometime during the September 16 to October 13 launch window. The craft was expected to take 11 months to cover the 450 million miles (740 million kilometers) to Mars. Once there, Mars Observer was expected to compile the first comprehensive database of Martian geophysics and climate. (*CSM*, Aug 26/92; *H Chron*, Aug 20/92)

August 4: Shuttle Atlantis' astronauts unreeled a tethered satellite in a risky electrical experiment never before tried in space, but the effort immediately ran into difficulties. Four hours and about a dozen tries were needed to free the satellite from the Shuttle. Then the unreeling tether line jammed twice, and the satellite ended the day about 850 feet instead of 12.5 miles from the Shuttle. NASA added an eighth day to Atlantis' mission because of problems with the Eureka and tethered satellite experiments. (*W Post*, Aug 5/92; *The Sun*, Aug 5/92; *LA Times*, Aug 5/92; *WSJ*, Aug 5/92; *USA Today*, Aug 5/92; *NY Times*, Aug 5/92; *P Inq*, Aug 5/92; *W Times*, Aug 5/92; *APn*, Aug 5/92; *UPI*, Aug 5/92; *C Trib*, Aug 5/92; *Time Magazine*, Aug 17/92)

August 5: NASA's Goddard Space Flight Center in Greenbelt, Maryland, said it had selected Lockheed Missiles & Space Company of Sunnyvale, California, to negotiate a cost-plus-award-fee, level-of-effort contract for the Hubble Space Telescope Mission Operations, Systems Engineering, and Software effort. The contract was in excess of \$100 million and was a follow-on to existing contracts. The proposed effort included maintenance of the spacecraft's health and safety, efficient operation of the observatory, systems management, and servicing mission support. (NASA Release C92-11)

- Astronauts on the Shuttle Atlantis cleared a snag in the tether cord linking the Italian-built satellite to the Shuttle and safely reeled the satellite back into the Shuttle's cargo bay, averting the need for an emergency space walk. The satellite flew above Atlantis for 24 hours, never going higher than 850

feet on the tether, far short of the 12.5 mile target. Even though the experiment fell short of its goal of generating electricity with a tethered satellite, the exercise showed that tethered vehicles probably can be reliably controlled in space. (*LA Times*, Aug 6/92; *P Inq*, Aug 6/92; *W Post*, Aug 6/92; *W Times*, Aug 6/92; *NY Times*, Aug 6/92, Aug 9/92; *USA Today*, Aug 6/92; *WSJ*, Aug 6/92; *APn*, Aug 6/92, Aug 8/92; *UPI*, Aug 6/92, Aug 7/92; *The Sun*, Aug 6/92; *AvWk*, Aug 10/92)

August 6: *Nature* magazine reported that astronomers had detected the most distant source known for very high-energy gamma rays—a galaxy with a powerhouse nucleus. The radiation is about a trillion times as energetic as ordinary starlight. Astronomers were puzzled as to how the Markarian 421 Galaxy, 20 times farther away than any other galaxy previously reported to emit such radiation, produces it. (*P Inq*, Aug 6/92)

- The Eureka satellite that failed to enter proper orbit after being released from the Shuttle Atlantis responded to commands to boost itself into a higher orbit. The reusable satellite held experiments using shrimp eggs, seeds, crystals, bacteria spores, solar monitors, cosmic dust catchers, and a telescope. It was slated to remain in orbit for several months before being retrieved and returned to Earth for study. (*P Inq*, Aug 7/92; *LA Times*, Aug 7/92; *NY Times*, Aug 7/92; *W Times*, Aug 7/92; *USA Today*, Aug 7/92; *The Sun*, Aug 7/92; *W Post*, Aug 7/92; *AvWk*, Aug 10/92)

- NASA announced that a Board of Investigation had been formed to assess the problem of the fouled tether that prevented the successful release of the Tethered Satellite System during Shuttle Atlantis' just-completed flight. NASA officials said that any decision about reflight of the \$380 million tether system would depend in part on a quick determination of what went wrong and how much it would cost to solve the problem. NASA set an August 28 deadline for the board to report its findings. (NASA Release 92-129; *W Post*, Aug 7/92; *AvWk*, Aug 10/92, Aug 17/92)

August 8: The Shuttle Atlantis landed at Cape Canaveral, Florida, ending a mission that deployed a European scientific satellite but that failed to complete an experiment with a tethered satellite. (*USA Today*, Aug 10/92; *UPI*, Aug 8/92; *P Inq*, Aug 9/92; *W Post*, Aug 9/92; *The Sun*, Aug 9/92; *W Times*, Aug 9/92; *NY Times*, Aug 9/92; *CSM*, Aug 10/92; *WSJ*, Aug 10/92)

August 9: The Associated Press reported that Japanese space officials recently had travelled to Russia for two weeks of talks and tours of previously off-limits space facilities. During the trip, the officials discussed a space cooperation treaty that would grant Japan access to Russian manned spaceflight data for use in medical research and to remote-sensing technology for use on satellites. (*AP*, Aug 9/92)

August 10: Russian space authorities reported that they had developed a new design for their Mir 2 Space Station and that initial production of the primary module had already started. The new Mir 2 design envisioned a core with five modules that were to be attached to the middle of a long beam. The officials said they expected Mir 2 to be launched in the mid-1990s and that it represented Russia's determination to continue its long-term plan of manned flight activities despite the difficult financial and political situation in Russia. (*AvWk*, Aug 10/92)

- A Russian industry grouping called the Space Regatta Consortium said it had developed and would test a prototype solar sail in 1992 as the first step in an ambitious program aimed at using such sails for spacecraft propulsion and other applications. The prototype sail was to be carried by a Progress cargo spacecraft scheduled for launch to the Mir 1 Space Station in late October or early November. Program managers envisioned a number of applications for solar sails in the future. One is as a means of propulsion for spacecraft. Another is to use huge sails as reflectors to illuminate selected points on Earth. (*AvWk*, Aug 10/92)
- European Space Agency mission controllers doubted that the Giotto spacecraft would be able to perform a flyby of a third comet. Scientists were enthusiastic about Giotto's encounter with Comet Grigg-Skjellerup on July 10, a followup on its original mission to Comet Halley in 1986. But low fuel supply and out-of-date communication systems probably signalled the end of Giotto's usefulness. (*AvWk*, Aug 10/92)
- A U.S.-French satellite roared into orbit aboard a European Ariane 4 rocket from Kourou, French Guiana. The \$706 million TOPEX/Poseidon satellite carried a \$30 million altimeter designed for NASA by Johns Hopkins University scientists to measure ocean topography to within 1.2 inches or less from 830 miles in space. During the next three to five years, scientists hoped to use the altimeter to make a comprehensive map of ocean currents, aiding the study of how they pump heat from the tropics to the poles. NASA said the research could eventually improve long-range climate forecasts and predict large-scale weather patterns, such as the El Niño warming trend in the eastern Pacific Ocean, and help in understanding the impact of greenhouse gases on climate. Also in the payload were a small South Korean communications satellite and a French technological satellite. (*The Sun*, Aug 10/92; *USA Today*, Aug 11/92; *AP*, Aug 10/92; *LA Times*, Aug 13/92)
- Two Russian cosmonauts and a French researcher landed safely in Kazakhstan after completing scientific experiments aboard the orbiting Mir Space Station. The 14-day mission brought to a close the third joint Russian-French flight since 1982. The three worked on experiments involving astrophysics, biology, and bioengineering. They also conducted geophysical

research based on commercial contracts from several European countries and members of the Commonwealth of Independent States. (AP, Aug 10/92; UPI, Aug 10/92; *The Sun*, Aug 11/92)

August 12: The National Science Board, the policy-making arm of the National Science Foundation, warned that the United States was losing its competitive edge in technologies of the future. Blaming government incompetence, leveraged buyouts, and executives' and investors' short-term focus, the panel urged increased public funding and changes in tax laws to counter technological competition from Europe and Japan. It said ways to improve performance included studying process technologies to make better products, training more engineers, and creating a better understanding of the role of research. (*LA Times*, Aug 13/92; *NY Times*, Aug 13/92; *W Post*, Aug 13/92)

- Scientists studying the effects of ozone depletion in Earth's atmosphere reported that the frequencies of light passing through a depleted ozone layer may not cause the widespread catastrophic damage to plants scientists previously predicted. They found that the kind of ultraviolet radiation that causes the most damage to alfalfa plants passes straight through the ozone layer, meaning a depleted ozone layer would not increase exposure to the most damaging light. Significant depletions in the ozone layer would certainly send up the cancer rate in humans quite substantially, biophysicist John Sutherland of the Brookhaven National Laboratory in Upton, New York, said, but plants are not likely to be the most severely affected by the increased ultraviolet light hitting Earth because of a thinning protective layer. (UPI, Aug 13/92)

- NASA Administrator Daniel S. Goldin charged a new team of agency officials with finding a cheaper way to build Space Station Freedom, even if that meant assembling much of it without the Space Shuttle. The team, comprised mainly of officials within NASA but outside the Station program, was asked to redesign the Station so that it can be completed on time despite congressionally imposed spending limits. Goldin's directive came in the wake of reduced Space Station funding in both the House of Representatives and the Senate. Findings were due to Goldin by November. (*Space News*, Aug 17/92; *AvWk*, Aug 24/92)

August 13: Scientists from NASA's Ames Research Center in Moffett Field, California, said they planned to seek answers to such problems as the development of frog eggs in weightlessness and control of space motion sickness on the next Shuttle flight scheduled for mid-September. Space Shuttle Endeavour was slated to carry a crew of seven, including a Japanese mission specialist, and Spacelab-J, a science laboratory containing 43 experiments, 34 of them provided by Japan, on a six-day mission. (NASA Releases 92-130 and 92-128)

August 14: A group of scientists said in today's issue of the journal *Science* that new studies prove that a buried crater in the Yucatan Peninsula of Mexico is the

point of impact of an asteroid that smashed into the Earth about 65 million years ago, contributing to the extinction of the dinosaurs. The Yucatan crater is big enough to be linked directly to ancient extinctions, and its mineral content is also compatible with that produced by an ancient explosion. Geologists, led by Carl C. Swisher III of the University of California at Berkeley, California, have dated rocks from the crater to 64.98 million years old, making the crater the leading candidate for a cataclysmic impact thought to have contributed to the mass extinction of life forms, including dinosaurs, 65 million years ago. (*NY Times*, Aug 14/92; *B Sun*, Aug 14/92; *C Trib*, Aug 14/92)

- Reacting to the recent failed attempt at tethered space flight by the crew of Shuttle Atlantis, Astronaut Jeffrey Hoffman, the payload commander, said NASA needed to improve the way equipment was tested on the ground before flight. "When we're doing fundamentally new things, we've really got to pay close attention to how we're doing the testing on the ground or else we're going to continue to get surprised," Hoffman said. (*APn*, Aug 14/92)

August 17: The launch of Consort 5, a commercial suborbital rocket carrying nine microgravity experiments, was scheduled for September 10 by the University of Alabama in Huntsville's Consortium for Materials Development in Space. A two-stage Starfire solid fuel rocket would carry the payload to an altitude of 200 miles and provide the experiments with seven to eight minutes of microgravity exposure or weightlessness. The rocket and launch services were funded by a grant from NASA's Office of Commercial Programs. (NASA Release 92-133)

- NASA announced that it had selected 31 experiments from the public and private sectors for inclusion in the Advanced Communications Technology Satellite (ACTS) Program. Scheduled for launch in early 1993, this national communications facility was to operate as an orbiting testbed for the next generation of commercial communications satellites. A two-year experiment, the ACTS program was designed to offer a unique opportunity for commercial, governmental, and academic organizations to experiment with and to validate new communications satellite technologies. (NASA Release 92-134)

- Some leading American astronomers complained about the failure of the Federal government to provide dependable financial support for astronomical research in the United States. The absence of dependable funding put American astronomy at a serious disadvantage in the competition with its counterparts in Europe and Japan, the astronomers charged. Federal financing had flagged, they said, just as a stream of new telescopes and telescope-enhancing devices were ready to be exploited. There were also management problems. Dr. Riccardo Giacconi, chief scientist for NASA's Hubble Space Telescope, charged that poor management of America's space and astronomy programs had hobbled efforts to compete with European science. (*NY Times*, Aug 18/92)

- The Air Force and NASA announced that they were developing a new family of rockets to meet the unmanned launch needs of the next century. As currently conceived, the National Launch System would include three new vehicles designed to lift cargoes ranging from 20,000 to 130,000 pounds into low Earth orbit. The new rockets were expected to become operational in 2002 and would carry supplies to Space Station Freedom at less cost than present U.S. delivery systems. (*W Times*, Aug 18/92; *Birmingham News*, Aug 19/92)

- The United States and France recently announced plans to increase civil space program cooperation. The two countries said they were also prepared to invite Russia to join with them in new cooperative endeavors. The focus of this new cooperation was the monitoring of the global environment and bringing France and Russia in with the United States as major partners on the Mission to Planet Earth program. The August 10 launch of the U.S./French Topex-Poseidon ocean survey satellite laid the foundation for the U.S./French initiative. (*AvWk*, Aug 17/92)

August 20: NASA researchers began a three-week airborne study to increase understanding of microscopic plant productivity in the equatorial region of the Pacific Ocean. The principal scientific objective was to understand why microscopic plant productivity involving phytoplankton is so limited in the Pacific compared to the Atlantic Ocean. (NASA Release 92-135)

- An experimental tilt-rotor forerunner of the controversial V-22 Osprey aircraft crashed during a routine training flight at Arlington, Texas, slightly injuring the pilot and co-pilot. Although the XV-15 looks much like the V-22 Osprey, a spokesman said the plane's development was not part of the V-22 program. The XV-15 resulted from cooperation between Bell Helicopter, NASA, and the Defense Advanced Research Project Agency. (*P Inq*, Aug 21/92; *WSJ*, Aug 21/92; *USA Today*, Aug 21/92; *AP*, Aug 20/82; *UPI*, Aug 20/92)

- Jeremiah Pearson, NASA's Associate Administrator for space flight, said NASA planners were studying ways to cut up to 25 percent from the Space Shuttle budget by 1997, a much more extensive reduction than previously projected. The 25 percent cut would produce savings of about \$3 billion, Pearson said. Managers at the Kennedy Space Center in Florida were already working to cut 10 percent from the Shuttle's 1994 budget. (*Space News*, Aug 24-30/92)

August 21: The journal *Science* carried reports by two teams of scientists who had found new evidence that speeding objects from space struck the Earth 370 million and 65 million years ago, possibly disrupting the global climate and causing mass extinctions. The scientists found tiny glass beads called microtektites in Belgian shale. The beads, more than 400 of which were found in a rock layer two to four inches thick, were reported to have round, elongated, teardrop

and dumbbell shapes. The scientists said geochemical analysis strongly suggested that they were produced from a cosmic collision. (*C Trib*, Aug 23/92)

August 22: An Atlas 1 rocket tumbled out of control after one of two Centaur second-stage engines failed to ignite, destroying a cable television satellite in a \$150 million failure for General Dynamics' commercial-launch business. It was the second catastrophic failure in seven flights for General Dynamics Space Systems Division of San Diego, California, which was trying to overtake the European consortium Arianespace for control of the world's commercial launch market. Lost with the Atlas 1 was a Galaxy 1R cable television relay station, a satellite built by Hughes Aircraft Company. (*UPI*, Aug 22/92; *WSJ*, Aug 24/92; *LA Times*, Aug 23/92)

August 24: The Association of Space Explorers Eighth Planetary Congress opened at Georgetown University in Washington, D.C. It was attended by the largest group of astronauts and cosmonauts ever assembled, with over 100 international space flyers, representing 19 nations, in attendance. The congress opened with remarks by NASA Administrator Daniel S. Goldin and was concerned mainly with discussions about an international mission to Mars. Goldin also mentioned the practical applications of NASA's technology innovations since the 1960s. He identified CAT scans, laser surgery, and intensive care units as having had their genesis in the space program. "New products, new industries, and new jobs come through NASA research," Goldin said. (NASA Note to Editors: N92-75; *W Times*, Aug 31/92)

- Officials at NASA's John F. Kennedy Space Center in Florida said that the agency had selected I-Net, Inc. of Bethesda, Maryland for negotiation of a contract to provide engineering support services to the center's Engineering Development Directorate. The contract was to run for five years and have an estimated value in excess of \$100 million. (NASA Release C92-12)

- NASA officials were reported to be focusing on a September 1994 Shuttle flight to rendezvous with the Russian Mir Space Station and possibly bring back a U.S. astronaut launched to the outpost earlier that summer. The Shuttle launch was tentatively scheduled for September 9, 1994, after extensive modifications to install a Russian docking fixture in the Shuttle Atlantis cargo bay. A different Shuttle mission scheduled for November 1993 was listed as a possibility for a flight featuring a Russian cosmonaut. (*Space News*, Aug 24/92)

August 25: The U.S. Air Force, NASA, and Grumman aircraft company said they had reached the mid-point of the X-29 vortex flow control (VFC) program at Edwards Air Force Base in California, producing yaw rates of up to 20 degrees. The use of VCF to yaw the aircraft while at a high angle-of-attack is an aviation first according to Col. William Gotcher, X-29 program manager. (*Flight International*, Aug 19-25/92)

August 27: NASA announced that the Mars Observer spacecraft was seriously contaminated with metal filings, paint chips, and other trash and could not be launched until it had been cleaned. The contamination may have been introduced when technicians tried to protect the spacecraft from possible damage from Hurricane Andrew. Originally scheduled for launch on September 16, NASA officials estimated a postponement of at least 10 days or possibly two weeks in the launch date. (*NY Times*, Aug 28/92; *AP*, Aug 28/92; *W Post*, Aug 29/92; *The Sun*, Aug 29/92; *W Times*, Aug 29/92)

- Scientists reported that the eruption of the Mount Pinatubo volcano in the Philippines last June sent massive amounts of sulfur dioxide into the atmosphere, which in turn was contributing to the erosion of Earth's protective ozone layer and to warming in the tropics. While the depletion could amount to 5 or 10 percent, the researchers expected the effect to be temporary. Detailed observations of the ozone layer were being made by NASA's Upper Atmosphere Research Satellite launched last year. (*UPI*, Aug 27/92)

August 28: The fifth meeting of the Space Agency Forum on the International Space Year (SAFISY) opened in Washington, DC. The forum is composed of 29 members (national and multinational space agencies), including NASA, and 10 affiliate members (international, space-related organizations). The meeting was called to review progress of the various SAFISY-sponsored international space year projects and to discuss options for post-1992 cooperation. (NASA Note to Editors N92-76)

- The Tethered Satellite System Investigative Board presented an interim report on the cause of the failure of the tethered satellite experiment on the Shuttle Atlantis mission earlier this month. Preliminary findings indicated that a bolt one-quarter of an inch in diameter got in the way of a reel of cord, causing it to jam. The bolt was part of a structural change made earlier this year to strengthen the tether system's attach points to withstand better the rigors of launch and landing, NASA said. Italian scientists hope to retry the experiment. A complete report was expected in about a month. (*AP*, Aug 29/92; *API*, Aug 28/92; *UPI*, Aug 28/92; *NY Times*, Aug 30/92; *C Trib*, Aug 30/92; *W Times*, Aug 29/92)

- In an interview with *Final Frontier* magazine, NASA Administrator Daniel S. Goldin gave his views about NASA and its contribution to American society. "I took this job because I believe NASA is critical to America's future. NASA provides hope, opportunity, and inspiration to the American public. It does this through its primary mission: to reach for the stars, in the broadest sense, of course. . . . For the last 30 years it has been demonstrated over and over again that the space program helps take America's value-added industry right to the cutting edge and provides jobs and opportunity." (*Final Frontier*, Sept/92)

August 30: For the first time, virtually every nation with an interest in space or its practical benefits sent delegates to the World Space Congress Meeting in Washington, DC. At the invitation of President George Bush, almost 4,000 representatives began a week of meetings that were expected to usher in a new era of international cooperation in space exploration. The conference was sponsored by the Committee on Space Research of the International Council of Scientific Unions, NASA, the U.S. Academy of Sciences, the International Astronautical Federation, and the American Institute of Aeronautics and Astronautics. (*The Sun*, Aug 31/92; CSM, Aug 31/92)

August 31: NASA announced that its Extreme Ultraviolet Explorer (EUVE) satellite had detected an object emitting extreme ultraviolet radiation located outside the Milky Way galaxy through interstellar dust and gas, once thought to block this source of radiation. EUVE also had detected a new source of extreme ultraviolet radiation coming from the corona of a star much like the Sun located about 16 light-years from Earth. The EUVE satellite, now six weeks into a survey of the entire sky in extreme ultraviolet wavelengths, was intended to provide astronomers with their first detailed maps in multiple extreme ultraviolet energy bands. (NASA Release 92-138)

September

September 1: NASA set September 12 as the launch date for the seven-day scientific mission of the Shuttle Endeavour. The 50th Shuttle mission was to include a number of Shuttle mission firsts: the first married couple, the first black woman, and the first Japanese astronaut on a U.S. spacecraft. (NASA Release STS-47 Launch Advisory; *USA Today*, Sept 2/92)

- NASA announced that its Search for Extraterrestrial Intelligence (SETI) program had been renamed the High Resolution Microwave Survey in a bid to defuse criticism of the program, especially by congressional budget-cutters. The new \$100 million program aimed to survey the entire sky by the year 2010 and specifically target about a thousand stars. (CSM, Sept 2/92)
- Lockheed Missiles and Space Company received two NASA contracts worth \$267 million for work on the Hubble Space Telescope. The flight systems contract, valued at \$147 million, includes funds for servicing missions, the first of which was set for December 1993 and was to deliver an optical instrument to correct the telescope's flawed mirror. (*WSJ*, Sept 2/92)
- Two Russian cosmonauts made a spacewalk to position a cable that will power an exterior engine on their Mir Space Station. (*AP* Sept 9/92)

September 2: International cooperation in space exploration and new opportunities between Western nations and the Russian Federation were among the topics NASA Administrator Daniel S. Goldin discussed in his address to the World Space Congress in Washington, DC. Goldin said the changes in governments around the world present challenges but also new opportunities. He said cooperation with Russia was among those opportunities. (*Spacewatch*, Sept 92)

- Orbital Sciences Corporation of Fairfax, Virginia said it had won a \$13.5 million contract from Brazil's civilian space agency to launch a remote-sensing and data-relay satellite in 1992. (*W Times*, Sept 2/92)
- The launch date of Mars Observer was rescheduled from September 16 to 25 in the aftermath of Hurricane Andrew. Although the hurricane passed well south of Cape Canaveral, the craft was nonetheless removed from the launch pad for protection. It required cleaning before it could be repositioned for launch, necessitating launch postponement. (NASA Release Launch Advisory, Sept 2/92; *W Post*, Sept 4/92; *AP* Sept 3/92)
- NASA selected Dr. Claude R. Canizares, head of the Astrophysics Division at Massachusetts Institute of Technology, as the new chairman of the Space Science and Applications Advisory Committee. (NASA Release 92-141)

September 3: At a meeting with NASA employees at Edwards Air Force Base, NASA Administrator Daniel S. Goldin emphasized the need for increased attention to aeronautics research in the face of competition from Europe and Japan. Goldin also said that NASA would have to do things “better, faster, cheaper”—the message Congress had just sent the agency by not increasing its \$14 billion budget. Goldin also urged senior management to place more minorities in its ranks and indicated that agency personnel would be reshuffled in the future. (*Daily News*, Sept 4/92; *Antelope Valley Press*, Sept 4/92)

September 4: Rockwell International and NPO Energia of Kaliningrad agreed September 4 to discuss cooperation in space flight and technology and to work together on a docking system that will connect the U.S. Space Shuttle to the Russian Mir Space Station. (*Space News*, Sept 14-20/92)

- NASA Administrator Daniel S. Goldin endorsed the creation of a Space Agency Forum to coordinate activities among the leaders of the world's space agencies to prevent duplication and overlap. (NASA Release 92-143)

September 8: NASA proposed to explore the planet Pluto by dispatching two small spacecraft with cameras and a few essential instruments as early as 1998 on flights taking them close to the planet in seven or eight years. Such a mission would utilize existing technology and cost an estimated \$400 million, an example of NASA's new philosophy of “better, faster, cheaper.” Scientists were anxious to send a mission to Pluto in the near future, since the planet was favorably positioned relative to Earth and its atmosphere was in a gaseous state, conditions that would not continue beyond about 2010. (*NY Times*, Sept 8/92; *CSM*, Nov 4/92)

- The Magellan spacecraft resumed its radar-imaging of Venus after a seven-week outage, making radar pictures of some of the last unmapped regions on Venus. Magellan was also scheduled to go into a lower orbit to measure Venus' gravity and to explore the planets' internal structure. The spacecraft has mapped 99 percent of Venus' landscape. Plans were under consideration to extend the life of the mission until November 1994 to obtain even more detailed pictures of Venus. (*AP*, Sept 9/94; *W Times*, Sept 9/92)

- Lockheed, a principal designer of NASA's Hubble Space Telescope, won \$267 million in contracts to maintain, service, and help repair the orbiting observatory. (*W Post*, Sept 9/92)

September 9: NASA scientists were baffled by a brownish discoloration, representing some kind of growth, on the Long Duration Exposure Facility (LDEF) satellite. The LDEF was retrieved by a Space Shuttle in January 1990. Whatever the growth, it had formed in space and despite high ultraviolet radiation and the corrosive power of atomic oxygen. (*W Times*, Sept 9/92)

- Rockwell International and a Russian company announced plans to collaborate on a system to enable the Space Shuttle Atlantis to dock with Russia's Mir Space Station. Rockwell said it had signed an agreement under which NPO Energia would develop hardware for the system and build some components. (AP, Sept 9/92)
- The U.S. Senate rejected by a wide margin a move to cancel NASA's international Space Station but forbade NASA from significantly changing the laboratory's design and schedule. If approved by the House of Representatives, the restriction would severely limit NASA's ability to overhaul key aspects of the program. (*Space News*, Sept 14-20/92)
- Orbital Sciences Corporation announced that it had reached a key milestone in development of the Taurus launch vehicle with the successful integration and testing of a full-scale engineering vehicle at its Chandler, Arizona, facilities. Taurus was designed to place payloads of up to 3,000 lbs. in low Earth orbit or 950 lbs. in geostationary transfer orbit. It was part of a program to develop a new class of U.S. launch vehicles that could be integrated, checked out, and launched on short notice. (*AvWk*, Sept 7/92)
- Joint NASA/FAA tests in Denver and Orlando showed that advanced, predictive sensor systems could provide airline crews up to 30 seconds warning of wind shears during takeoff and landing phases of flight. Of three forward-looking sensors tested, the modified Doppler weather radar detected wind shear consistently and at longer ranges than light detection and ranging systems or infrared sensors. Wind shear caused more than 26 U.S. air carrier accidents between 1964 and 1985. (*AvWk*, Sept 7/92)
- NASA announced that five contractors had been selected to develop designs for two Earth Observing Systems spacecraft, EOS-PM and EOS Chemistry, scheduled for launch in 2000 and 2002, respectively. NASA planned to spend about \$12 million on the five studies. (*AvWk*, Sept 7/92)
- Leaders of the world's space nations attending the World Space Congress in Washington, D.C., last week said that they lacked the money to go it alone in space, yet the will to cooperate internationally seemed also to be lacking. Two views about space exploration emerged among scientists. An optimistic view held that space exploration methods could be worthwhile projects at affordable prices. The pessimistic view held that space cost too much, lacked public support, and that ideas must be constrained. The Congress, the largest gathering of space experts ever convened, attracted more than 5,000 delegates from 70 nations and featured more than 2,700 technical papers. (*Space News*, Sept 7-13/92)
- The Senate approved funding of \$2.1 billion for continuation of the Space Station after defeating a proposal to close down the project because of its

expense. The Senate vote, together with House approval in July, assured continued funding and congressional support for the Space Station. (*W Post*, Sept 10/92; *LA Times*, Sept 10/92; *WSJ*, Sept 10/92; *AP*, Sept 10/92)

September 10: A Starfire I rocket manufactured by EER Systems Corporation of Vienna, Virginia failed to achieve suborbital flight after launch from the White Sands Missile Range. The flight carried nine microgravity experiments. At a cost of \$3 million, the Starfire rocket was thought to be an inexpensive way to carry out experiments without the costs associated with programs such as the Space Shuttle. (*Las Cruces, NM, Sun News*, Sept 11/92; *El Paso Times*, Sept 11/92)

September 11: The Boeing Aircraft Company announced plans to produce some jetliner parts in the former Soviet Union as soon as possible. The effort would enable Boeing to gain increased access to the Russian aviation market and to meet stiff competition from Russian and European firms. (*WSJ*, Sept 11/92)

- NASA announced that a Space Shuttle flight link up with the Russian Mir Space Station, tentatively planned for September 1994, would be retargeted for launch in April 1995. A flight by a Russian cosmonaut aboard the Shuttle Discovery remained on track for launch on November 16, 1993. The first flight to begin building the planned Space Station Freedom was rescheduled for July 1996. (*Space News*, Sept 14-20/92)

- In an interview in Huntsville, Alabama, Vice Presidential candidate Al Gore said that a Clinton administration would support a return to the Moon and Mars but would not commit major resources to such efforts. Given other current NASA priorities, Gore said the longer-range mission to Mars "must be pursued according to a sensible timetable." (*Htsvl Tms*, Sept 11/92)

- Scientists studying data from Jupiter's highly charged magnetic environment reported that the solar wind exerts a much stronger influence on the planet's magnetic field than previously thought. The discovery was the result of the unique trajectory of the spacecraft Ulysses, a joint NASA-European Space Agency mission on its way to study the poles of the Sun. (NASA Release 92-145)

September 12: The Space Shuttle Endeavour roared into orbit on September 12 on a history-making seven-day mission. It carried the first married couple, Mark Lee and Jan Davis; the first Black woman, Mae Jemison; and the first Japanese person, Mamoru Mohri; to fly on a U.S. spacecraft. It also carried fish, frogs, hornets, flies, and fertilized chicken eggs, all subjects of the research mission. Endeavour's flight was also the first U.S. space mission devoted to Japanese research. Japan supplied 34 of the 43 Spacelab experiments, the United States seven, and two were shared. Japan contributed \$90 million of the estimated \$363 million cost of the flight. (*CSM*, Sept 14/92; *W Post*, Sept 13/92; *W Times*, Sept 13/92; *NY Times*, Sept 13/92; *The Sun*, Sept 13/92; *P Inq*,

Sept 13/92; *W Times*, Sept 12/92; *W Post*, Sept 12/92; *The Sun*, Sept 12/92; *C Trib*, Sept 12/92;)

September 13: On their first full day in space, two crew members of the Space Shuttle Endeavour conducted experiments involving motion sickness. Understanding motion sickness has high priority among space agencies around the world. It strikes most astronauts during their first few days in space, and it affects flight planning, such as space walks, which are never scheduled early in a mission. (*W Post*, Sept 14/92; *NY Times*, Sept 14/92; *W Times*, Sept 14/92; *AP*, Sept 14/92; *W Post*, Sept 13/92)

September 14: In the summer 1992 issue of *Phi Kappa Phi Journal*, Richard H. Kohrs, Director of Space Station Freedom in NASA's Office of Space Development, discussed the advantages and challenge of constructing Space Station Freedom. Aside from the international cooperation required to build and operate it, Kohrs gave three primary functions that the Space Station would perform in the U.S. civil space program: 1) it would enable humans to learn to live and work productively in space; 2) it would serve as an advanced research facility; and 3) it would provide experience and knowledge of building, operating, and maintaining large systems in space. The Space Station was also expected to be a vital component of the total U.S. civil space program, augmenting the planetary exploration program, astronomical research, life-sciences program, aeronautics research, and transportation program. (*Phi Kappa Phi Journal*, Summer 1992)

- Astronauts aboard the Space Shuttle Endeavour resumed science work after successful repairs Sunday night on a set of water-cooled furnaces critical to several of the 43 experiments aboard the shuttle. The crew observed irradiated fruit fly larvae, fertilized frog eggs, kept tabs on two fish with electrodes attached to their brains, and tested a new manufacturing method for electronic components. (*NY Times*, Sept 15/92; *W Times*, Sept 15/92; *W Post*, Sept 15/92; *The Sun*, Sept 15/92)

- Deidre Lee was appointed Deputy Assistant Administrator for Procurement at NASA Headquarters. (NASA Release 92-146; *Space News*, Sept 21-27/92)

September 15: The Magellan spacecraft fired its four thrusters to swoop within 113 miles of the surface of Venus for study of the planet's gravity and prominent surface details. Since its deployment in 1989, the Venus probe has used radar to map 99 percent of the planet, exceeding its goal of 70-90 percent. With its mission completed beyond expectations, NASA scientists expected to shut down Magellan in May 1993 as a cost-cutting measure. (NASA Release 92-148; *USA Today*, Sept 15/92; *LA Times*, Sept 15/92)

- A NASA Ames Research ER-2 aircraft was scheduled to take high altitude aerial images of the Hawaiian Islands to help officials determine the full extent of the damage caused by Hurricane Iniki. (NASA Release 92-149)

- Weather satellite officials at the National Oceanic and Atmospheric Administration expressed concern about the heightened danger from hurricanes because of delays in modernizing the U.S. weather satellite system. The delays forced the use of antiquated and poorly positioned satellites that raised the risk of forecasting errors. Two hurricanes, Andrew and Iniki, showed the limits of the antiquated satellites. Replacement satellites were stymied by a series of technical failures, delaying the first launching from 1989 to 1994. In the meantime, the United States was borrowing surplus satellites from Europe. (*NY Times*, Sept 15/92; *W Times*, Nov 15/92)
- NASA managers said last week that they would refashion the way the Space Agency conducts its programs, drawing on the results of internal NASA studies now under way and the advice of outside groups. The proposed reforms would serve as a test of whether Administrator Daniel S. Goldin's vision of faster and cheaper space projects could work in practice. (NASA Release 92-154; *Space News*, Sept 14-20/92)
- Dr. David M. Rust, chief scientist for the Flare Genesis project, a powerful solar telescope project developed by a team at Johns Hopkins University, said the telescope could be launched as early as December 1993. Rather than be launched on a NASA rocket or from a Space Shuttle, which might take a decade of planning and cost hundreds of millions of dollars, the telescope was to be dragged 19 miles above Antarctica by a balloon. The project would be another in a series of long-duration research flights using large balloons. Project scientists hoped to use the telescope to explore the precise cause of solar flares. (*The Sun*, Sept 15/92)
- NASA scientists announced that they would use "telepresence" technology in the Antarctic this fall to see if life that existed millions of years ago on Earth could provide clues about organisms that once may have lived on Mars. A team was scheduled to travel to Antarctica in October to study sediment on the bottom of ice-covered Lake Hoare on Ross Island. (NASA Release 92-147)
- An editorial in *Aviation Week & Space Technology* lamented the lack of priorities in developing more new space launch and propulsion systems than the United States could possibly use. It stated that the White House, Congress, NASA, the Defense Department, and other agencies involved in space transportation are the bodies that should lay out a realistic national plan to develop new launch systems and technologies. (*AvWk*, Sept 14/92)
- The European Space Agency (ESA) reported last week that Hermes, the ESA's spaceplane program, already scaled back to an unmanned demonstrator, would have to be downgraded to a technology development program because of budgetary constraints. On another project, ESA's scientists were evaluating data from a test of inter-satellite communications conducted by Eureka, ESA's large, retrievable satellite. (*AvWk*, Sept 14/92)

- The National Center for Advanced Technologies received a two-year, \$200,000 grant from NASA and the Aerospace Industries Association to study civil space technology needs and technology transfer mechanisms. (*AvWk*, Sept 14/92)
- According to a report in *Aviation Week & Space Technology*, wind tunnel facilities at Russia's Sibia Research and Development Center were being made available to Western companies. (*AvWk*, Sept 14/92)
- NASA Administrator Daniel S. Goldin appeared ready to abandon the X-30 National Aerospace Plane program with its goal of constructing and flying a single-stage-to-orbit air-breathing vehicle in favor of a hypersonic research effort. The latter, the NASA Ames-Dryden Flight Research Facility effort, centers on a manned, Mach 10-class reusable test aircraft launched from the back of a NASA/Lockheed SR-71A, and on an unmanned platform launched atop a rocket to explore physical phenomena at speeds approaching Mach 25. (*AvWk*, Sept 14/92)
- NASA acknowledged that it could not keep the Space Station project on schedule even with the most optimistic current funding projections. The projected level of congressional appropriations for the next few years meant certain delays in development and launch schedules of anything up to 12 or 18 months. Such delays would mean that the station would miss the official December 1999 target for being able to support a crew on a permanent basis. (*AvWk*, Sept 14/92)
- The National Aerospace Plane program applied a battery of optical instrumentation to the problem of measuring the chemistry and aerodynamics of a hypersonic combustor during 0.002-second shock tunnel test runs. The NASP test environment has the unique challenge of a high Mach number, short run time, and a flow so energetic that measurements were obscured by the brightly glowing air. (*AvWk*, Sept 14/92)
- *Space* magazine carried an assessment of NASA's new Administrator, Daniel S. Goldin, five months after his confirmation as NASA's chief. Goldin's task was to drag NASA out of its doldrums by sheer force of will. In his first five months, Goldin had already shaken up the U.S. space agency by applying business and management practices honed at the helm of some of TRW Corporation's most significant space projects, such as total quality management. The *Huntsville News* viewed Goldin as an agent of change, determined to revamp NASA from within. (*Space*, Aug-Sept 92; *Htsvl Tms*, Sept 3/92)
- Shuttle Endeavour's astronauts reported abnormal behavior for tadpoles hatched aboard the shuttle. Oriental hornets similarly displayed confused,

disoriented behavior, seemingly unable to build nests in a weightless environment. The tadpoles and hornets were part of 43 experiments in weightless conditions being carried out on the Shuttle. (*UPI*, Sept 15/92; *W Times*, Sept 16/92; *UPI*, Sept 16/92; *AP*, Sept 16/92)

- Two Russian cosmonauts on Tuesday completed a series of spacewalks to install an engine and move an antenna on the Mir Space Station, partly in preparation for docking with a U.S. Space Shuttle in 1994. (*AP*, Sept 15/92)

- *September 16*: Astronomers reported that they had recently detected a small faint object beyond Neptune and Pluto that could be the first direct evidence for the existence of the Kuiper belt, a broad belt of icy minor planets that is presumably the source of many short-period comets streaking in from the fringes of the solar system. Initial observations suggested that the object is about 120 miles in diameter, has a reddish glow, and is traveling in a 200-year orbit between 3.4 and 5.5 billion miles from the Sun. (*NY Times*, Sept 16/92; *W Post*, Sept 16/92; *Time*, Sept 28/92)

- The U.S. Defense Department announced that it had no further plans to use the Space Shuttle for major payloads after launch of a classified military satellite during a Shuttle flight in November. The Pentagon, which once had planned to be a prime user of the space shuttles, was to be relegated to a minor and occasional Shuttle customer. In place of the Shuttles, the Pentagon planned to rely much more heavily on expendable launch vehicles for military payloads. (*Space News*, Sept 14-20/92)

September 17: Dr. Wesley T. Huntress, Jr., Director of NASA's Solar System Exploration Division, last week received the Korolev Medal, awarded by the Russian Federation of Astronautics and Cosmonautics for achievement in space research. (NASA Releasase 92-151)

September 18: Astronauts aboard the Space Shuttle Endeavour began testing a system to deliver intravenous fluids in weightlessness, a step toward meeting the possible medical needs of astronauts who stay in space long-term. (*AP* Sept 18/92)

- Dick Weinstein, manager of engineering standards and practices for NASA, said NASA was predominantly non-metric and likely to stay that way in view of a September 30, 1992, deadline for the United States to convert to the metric system. Weinstein predicted, however, that by 1995 NASA would be well into the conversion process. (*Washington Technology*, Sept 10/92)

- The Pentagon, bowing to congressional pressure, revealed the existence of the super-secret agency that buys and operates the Nation's spy satellites and its other airborne espionage systems. The National Reconnaissance Office's mission is to ensure that the United States has the technology and spaceborne

and airborne assets needed to acquire intelligence worldwide, according to the Pentagon. (*P Inq*, Sept 1992; *C Trib*, Sept 18/92)

- NASA announced signature of a \$59.3 million supplemental agreement with Rockwell International's Space Systems Division for the design, development, test, and evaluation of a new system to update Space Shuttle orbiter cockpit displays. (NASA Release C92-15)

September 20: The Space Shuttle returned to Earth with its seven-member crew, two Japanese carp, four frogs and assorted tadpoles, hornets, and flies. This was the first Shuttle flight devoted to Japanese research. (*NY Times*, Sept 21/92; *P Inq*, Sept 21/92; *The Sun*, Sept 21/92; *W Times*, Sept 20/92, Sept 21/92; *W Post*, Sept 20/92, Sept 21/92; *AP*, Sept 20/92, Sept 21/92; *UPI*, Sept 21/92; *USA Today*, Sept 21/92; *LA Times*, Sept 21/92)

- A new 5,000-mile-wide radio telescope designed to probe the edge of the universe was near completion in the United States, according to Peter Napier, project manager for the Very Long Baseline Array project. The federally funded project, actually a series of 10 dish-shaped antennas, was expected to begin high-resolution imaging work by December. (*W Times*, Sept 20/92)

September 21: A satellite launched to study oceans and global climate was maneuvered into position Monday for months of tests before beginning its mission. The TOPEX/Poseidon, the first major space mission conducted jointly by the United States and France, was launched August 10 from French Guiana. (*AP*, Sept 21/92)

- The first student-managed and built payload flown on a NASA sounding rocket was launched successfully from the NASA flight facility on Wallops Island, Virginia. (NASA Release 92-156)

September 22: A NASA airplane, equipped with delicate instruments, carried three astronomers to 41,000 feet above Hawaii last month to examine indications of a "black hole" at the heart of the Milky Way Galaxy. The launch of the Hubble Space Telescope and improvements in ground-based instruments led to several announcements this year of tangible evidence for the existence of "black holes." (*LA Times*, Sept 21/92)

- House-Senate negotiators agreed yesterday to provide \$2.1 billion next fiscal year for Space Station Freedom. The agreement spelled the end of another year of efforts by opponents to kill a program they consider too expensive and of little scientific value. The Space Station was expected to cost \$40 billion to build and \$100 billion more to operate over its planned 30-year lifetime. (*W Post*, Sept 23/92; *USA Today*, Sept 23/92; *LA Times*, Sept 23/92; *The Sun*, Sept 23/92; *AP*, Sept 23/92)

- NASA inspectors announced that they had discovered a pinhole-size leak in an O-ring seal of a solid rocket booster intended for Space Shuttle Discovery's November 15 launch. Technicians replaced the seal, which was similar to the one that caused the 1986 Challenger explosion. (*USA Today*, Sept 23/92; *W Times*, Sept 23/92; *AP*, Sept 23; *UPI*, Sept 23/92)

- NASA announced plans to revamp its cumbersome procurement rules to entice more small businesses to bid for contracts as a way of ensuring continued technological and economic growth in the United States. (*Fla Today*, Sept 23/92; *Space News*, Sept 28-Oct 4/92)

September 23: A pinched piece of rubber filler—not a faulty O-ring seal—caused a leak in a solid rocket booster being readied for the launch of Space Shuttle Discovery, NASA said. The booster's three O-rings seals were in good condition. (*AP*, Sept 24/92; *UPn*, Sept 24/92; *W Times*, Sept 25/92)

- NASA announced that congressionally imposed funding limits for Space Station Freedom would delay its full operation by about nine months. Under a revised schedule, NASA would begin launching parts of the Space Station in March 1996, a four-month delay. The station would be ready for limited astronaut use in June 1997 and for full astronaut use in June 2000, a nine-month delay. (*Space News*, Sept 28-October 4/92)

- NASA announced that more than 200 scientists from 13 countries were participating in a science expedition, spearheaded by NASA, to investigate newly discovered concentrations of harmful ozone over large regions of southern Africa and Brazil. The ozone pollution was recently uncovered by satellite analysis. (NASA Release 92-155)

September 24: NASA and the Federal Aviation Administration began evaluating new technology that could substantially improve the efficiency of the Nation's air traffic system, including improved on-time arrivals, increased fuel efficiency, and a decreased work load for air traffic controllers, according to scientists at NASA's Ames Research Center. (*Commercial Aviation News*, Sept 22/92)

September 25: NASA's Mars Observer space probe, the first American mission to Mars in 17 years, blasted off from Cape Canaveral. The probe was to search for future landing sites and map the planet's geology and climate. Despite a radio blackout before a critical rocket firing that left flight controllers in the dark for nearly two hours, the spacecraft was successfully boosted out of Earth orbit on an 11-month, 450-million-mile journey to Mars after a flawless launch atop a Titan 3 rocket. It was also the first mission for the Transfer Orbit Stage, a 13-foot thrusting unit designed to fire for two and a half minutes to provide the final shove to put the probe on its 11-month coast to Mars. The launch heralded an era of unprecedented United States-Russian cooperation in space.

Eleven Russians were part of the spacecraft's science team, and the orbiter was designed to help relay pictures and data from Russian probes scheduled to land on Mars in 1995 and 1997. (*UPI*, Sept 25/92, Sept 26/92; *AP*, Sept 25/92, Sept 26/92; *W Post*, Sept 25/92, Sept 29/92; *The Sun*, Sept 26/92, Sept 27/92; *P Inq*, Sept 26/92, Sept 27/92; *NY Times*, Sept 26/92; *W Times*, Sept 26/92)

- Air Force officials employed a revised and more accurate computer model of wind direction and speed in the launch of the Mars Observer. The officials insisted on ideal weather conditions before allowing the launch because of concerns that a plume of harmful nitrogen tetroxide could drift over nearby populated areas should the Titan 3 rocket explode within the first 20 to 30 seconds of flight. The new computer model allows the Martin Marietta-built Titan family of rockets to continue as launch vehicles, although the modelling may make it more difficult to launch on time. (*Fla Today*, Oct 4/92)

- The House of Representatives voted to spend \$2.1 billion next year for work on NASA's Space Station Freedom as opponents ended their efforts to scuttle the project. (*The Sun*, Sept 26/92; *W Times*, Sept 26/92)

- NASA Administrator Daniel S. Goldin announced new minority contract goals and the formation of a NASA Minority Business Resource Advisory Committee. He also announced that the Minority Contractor of the Year was Jackson & Tull, Chartered Engineers, of Seabrook, Maryland; B & W Services, Inc., Bay St. Louis, Mississippi, was selected as Minority Subcontractor of the Year. (NASA Release 92-158)

September 26: A Japanese amateur astronomer detected Comet Swift-Tuttle on its return to the inner solar system. Swift-Tuttle, last seen during the American Civil War, is currently the longest predictable periodic comet, returning approximately every 130 years. (*W Post*, Sept 29/92; *NY Times*, Sept 30/92)

September 27: Germany announced that it would go ahead with a celebration to mark the 50th anniversary of the first launch of the V-2 rocket despite British protests. The organizers said the event would celebrate the "first step into space" and did not represent a glorification of a Nazi weapon. (*W Post*, Sept 28/92; *The Sun*, Sept 26/92)

- Douglas Broome, Jr., Deputy Director of the solar system exploration division at NASA, died of liver cancer September 27 in Fairfax, Virginia. (*W Post*, Sept 30/92; *W Times*, Sept 30/92)

September 28: James Abrahamson, former director of the Strategic Defense Initiative, left Hughes Aircraft to serve as co-chairman of Oracle Systems. A former Air Force general, Abrahamson was expected to supervise such projects as NASA's Space Shuttle and the Air Force's F-16 fighter. (*Bus Wk*, Sept 28/92)

- A high-powered panel of space experts appointed by U.S. Vice President Dan Quayle was scheduled to begin deliberations on October 1 that were intended to lay the groundwork for a revamped U.S. space program. The 11-person panel was to advise on ways to change the space effort in light of the Cold War's end, tight budgets, and rapid technological advancements. (*Space News*, Sept 28-Oct 4/92)
- Reacting to a wave of international protest and some severe domestic criticism, Germany canceled a celebration of the 50th anniversary of the first successful V-2 rocket launch at the Peenemunde range on the north German coast. The first V-2 rocket was fired on October 3, 1942, under the direction of Wernher von Braun, then a young scientist. The date is generally recognized as the birth of the space age. (*LA Times*, Sept 29/92; *W Post*, Sept 29/92)
- NASA and Thiokol Corporation officials were working on a modification to prevent a field joint lining from creating leaks in the cases of solid rocket boosters for the Space Shuttle. This effort came after engineers discovered a leak in a segment of the booster rocket assembled for the Space Shuttle Discovery's scheduled November launch. (*AvWk*, Sept 28/92)
- An experimental aircraft known as the X-31 had flown maneuvers at a 70-degree angle of attack, the Pentagon announced. All of the plane's experimental flights were flown at the NASA Ames-Dryden Flight Research Facility in Edwards, California. (*AP*, Sept 28/92)

September 29: Scientists at Lawrence Livermore National Laboratory in California announced plans to blast an 11-pound projectile from a 155-foot-long cannon into a California hill. The test shot was intended to demonstrate that an ultra-high-velocity gun hitherto used only for laboratory research can be adapted to send payloads into space at only about one-fortieth of what it costs to orbit them by Space Shuttle. The gun was the product of a program called the Super High Altitude Research Project. (*NY Times*, Sept 29/92)

- NASA Administrator Daniel S. Goldin announced in a number of speeches the first major reforms resulting from the internal review of NASA programs he had ordered. The Earth Observing System would be streamlined again, and incentives to Space Station Freedom contractors might be pooled to assure that they worked as a team. The reforms were designed to make U.S. civil space programs better, faster, and cheaper. Money saved would be applied to new missions using small spacecraft. (*AvWk*, Sept 28/92; *Science*, Oct 2/92)
- General Motors and Ford automotive companies began experimenting with technology derived from the National Aerospace Plane (NASP) project. Both companies were testing automobiles equipped with titanium aluminide valves. Application of existing NASP materials technology to current automobile

engines could reduce the weight of their moving parts by 50 percent, increasing fuel efficiency and durability, according to materials scientists. (*AvWk*, Sept 28/92)

- The Galileo space probe, on its way to study the planet Jupiter, recently passed within 5,300 kilometers (3,300 miles) of the asteroid 951 Gaspra, and scientists instructed it to take the first ever closeup photo of such an object. The irregular shape suggests that Gaspra was chipped from a larger body in a mammoth collision. (*Time*, Sept 28/92)
- NASA selected Hughes Aircraft Company to build a data and information system for the Earth Orbiting System. The program, which would collect environmental data from satellites, was expected to cost NASA about \$3 billion. (NASA Release C92-16; *NY Times*, Sept 30/92; *WSJ*, Sept 30/92; *W Post*, Sept 30/92; *AvWk*, Oct 5/92)
- NASA announced that satellite measurements showed that the ozone hole over Antarctica was now the largest on record, being almost three times as large as the area of the United States. Measurements by the Total Ozone Mapping Spectrometer instrument aboard the Nimbus-7 satellite last Wednesday showed that the south polar territory under the depleted ozone area extended to about 8.9 million square miles, about 15 percent larger than the ozone hole measured in 1991. (NASA Release 92-159; *W Post*, Sept 30/92; *Time*, Oct 5/92; *AP*, Sept 30/92; *UPI*, Sept 30/92)
- The Pentagon said that the crash of an experimental V-22 Osprey tilt-rotor aircraft that claimed seven lives in July was caused by a combination of a flash fire, engine failure, and a failed drive shaft. The statement did not make clear whether the problems arose from a design flaw or some defect in a part or parts. (*P Inq*, Sept 30/92; *NY Times*, Sept 30/92)

September 30: A bipartisan group of prominent Americans proposed a plan to reduce government spending, invest in growth, and reshape the income tax system in the hope of balancing the Federal budget in a decade. Decisions on which programs would be cut were left to Congress and the president, but the group suggested that NASA's planned Space Station, mass transit operating aid to cities, and other programs would be prime candidates for funding reductions. (*AP*, Sept 30/92)

- Shuttle managers said budget-cutting goals recently mandated by NASA Administrator Daniel S. Goldin could mean the loss of as many as 800 jobs on top of the 300 to 400 being phased out during the new fiscal year at the Kennedy Space Center. The cuts were part of Goldin's pledge to run a leaner, more efficient space agency. (*O Sen Star*, Sept 30/92)

- The National Research Council said NASA should increase its budget for civil airliner and air traffic control research, even if it means a cutback in NASA's military and space programs. The council, an arm of the National Academy of Sciences, said the United States status as the world leader in aircraft manufacturing would continue to erode if NASA did not enter into a major cooperative program with industry, universities, and other government agencies to develop a new generation of airliners. (*W Post*, Oct 1/92)

October

October 1: The Navy said yesterday that a July 20 crash of a V-22 Osprey tilt-rotor aircraft outside Washington had been caused by oil or transmission fluid being sucked into one of the aircraft's two engines and not by a fuel leak as had been reported earlier. All seven crewmen were killed when the aircraft crashed. (*P Inq*, Oct 2/92)

- Astronaut John Young was awarded the NASA Outstanding Leadership Medal today by NASA Administrator Daniel S. Goldin at NASA Headquarters in Washington, DC. Young, 62, was currently serving as Special Assistant to the Director of the Johnson Space Center, Houston, for Engineering, Operations, and Safety. (NASA Release 92-160; *Fla Today*, Oct 11/92)

- The National Association of Small Disadvantaged Business presented NASA Administrator Daniel S. Goldin with its Meritorious Award. It was the second time Goldin had received the award. (NASA Release 92-162)

October 2: Ceremonies at Edwards Air Force Base marked the 50th anniversary of the birth of the jet age. On October 2, 1942, Bob Stanley first flew the XP-59 above Rogers Dry Lake Bed at Muroc Air Base (now Edwards Air Force Base). (*Antelope Valley Press*, Oct 2/92)

- The first meetings of the National Space Policy Assessment Task Group took place on October 1 and 2 in Washington, DC. The group was considering policy changes to military, civilian, and commercial space efforts and ways to make them work more in tandem now that the Cold War had ended. At the meetings, government officials urged the group's members to privatize the weather satellite system, to call for revamping commercial space rules, and to decry missile proliferation. (*Space News*, Oct 5-11/92)

- Defense contractor Teledyne, Inc., announced that it would pay \$17.5 million in fines to settle Federal criminal charges alleging that the company systematically falsified reliability tests of electromagnetic relays. The relays are used in virtually all U.S. weapons systems and space programs, including the Patriot missile and the Space Shuttle. It was not known if any systems failures had been caused by the relays, which function as electronic switches. (*AP* Oct 3/92)

- NASA announced that extended observations by the Hubble Space Telescope indicated that Jupiter's moon Io has a smaller atmosphere than previously thought, with very dense regions possibly over volcanoes and surface frost. The observations also showed that despite continual volcanic activity, Io's surface has remained largely unchanged since first photographed by the

Voyager spacecraft in 1979. (NASA Release 92-163)

October 3: The Pioneer Venus orbiter ran out of thruster propellant today after circling Venus for 14 years. The orbiter was expected to burn up in Venus' atmosphere sometime in the coming week. The orbiter was the first U.S. spacecraft to circle Venus. It used a crude radar to map more than 90 percent of the planet's surface. (AP, Oct 3/92; UPI, Oct 3/92, Oct 5/92; W Times, Oct 5/92; NY Times, Oct 6/92)

October 4: John L. Sloop, 76, an electrical engineer who was a retired official of NASA, died in Washington, DC. Mr. Sloop retired in 1972 as Assistant Associate Administrator for Advanced Research and Propulsion after a 30-year career with NASA and its predecessor, the National Advisory Committee for Aeronautics. (W Post, Oct 7/92)

- Zoltan L. Bay, a research physicist who developed the first radar to study celestial bodies, died of emphysema at his home in Chevy Chase, Maryland. Born in Hungary, he taught physics at Szeged University in the 1930s and was research professor at George Washington University before joining the National Bureau of Standards in 1955. (W Post, Oct 11/92; C Trib, Oct 11/92)

October 5: NASA's funding remained flat as congressional appropriations committees completed work on NASA's 1993 budget. Although some high-profile programs such as the Space Station and a constellation of environmental monitoring satellites emerged virtually unscathed, newer or less visible efforts suffered setbacks. An advanced series of tracking satellites, robotic missions to the Moon, and a new generation of launchers were among the efforts put on hold for at least the next year. Spending on space research and technology was reduced by 13 percent. (Space News, Oct 5-11/92)

- NASA announced that asteroid Toutatis would pass within 2.2 million miles of Earth on October 8, an unusually close encounter. Toutatis is about two miles in diameter and passes Earth every four years, making it one of the largest objects to cross Earth's orbit on a regular basis. In 2004 Toutatis would pass within one million miles of Earth. (NASA Release 92-164; UPI Oct 5/92)

- Directors of the U.S. and Russian space agencies announced plans in Moscow to put a Russian cosmonaut on the Space Shuttle in November 1993 and to fly an American astronaut on a Soyuz rocket to the Mir Space Station in 1995. In addition to the projects involving cosmonauts and astronauts working together in space, plans were announced to put American instruments on board an unmanned Russian scientific flight to Mars in 1994. (NASA Release 92-165; UPI Oct 5/92; NY Times, Oct 6/95; W Times, Oct 6/92; W Post, Oct 6/92; The Sun; Oct 6/92; AvWk, Oct 12/92; SCM, Oct 14/92)

October 6: NASA set an October 22 launch date for Space Shuttle

Columbia's satellite-delivery and research mission. The six-member crew was to release the Italian Space Agency's Laser Geodynamic Satellite, or Lageos, then conduct spacecraft tracking experiments and mechanical and medical tests. (NASA Release N92-88; *LA Times*, Oct 7/92)

- NASA announced that Sergei K. Krikalev and Col. Vladimir G. Titov had been approved as the two Russian candidates to be trained to fly on a Space Shuttle mission scheduled for November 1993. (NASA Release 92-166)
- NASA announced that it had awarded about \$15 million for 124 micro-gravity research grants to develop the research potential of Space Station Freedom as one of the Nation's premiere science and technology assets. The grants represent an increase of 70 percent in the number of investigators sponsored by NASA's microgravity division. The division now sponsors nearly 200 scientific investigators and plans to expand to at least 300 before the Agency's planned Space Station becomes operational in the late 1990s. (NASA Release 92-167; *Fla Today*, Oct 11/92)
- President George Bush signed an appropriations bill providing \$2.1 billion for NASA's Space Station in fiscal year 1993. Other projects to be funded include the Consortium for International Earth Science Information Network, which was to provide social scientists with Earth science data beamed from NASA environmental monitoring satellites to understand issues such as land use and population growth. A program for developing a new NASA-Pentagon rocket to put satellites into space, ensuring continued use of Martin Marietta's Titan IV booster for satellite launchings, was terminated. (*P Inq*, Oct 7/92; *AP* Oct, 7/92; *W Post*, Oct 7/92; *Space News*, Oct 12-18)
- Congress planned to give the fledgling U.S. commercial space business a boost next year by pumping \$10 million into launch site improvements. Most of that money was expected to be spent on upgrades to Cape Canaveral Air Force Station facilities. (*Fla Today*, Oct 8/92)

October 8: Hubble Space Telescope scientists announced that Hubble has used a natural "zoom lens" it discovered in space to photograph an otherwise invisible distant galaxy and to chart concentrations of the mysterious dark matter that controls the fate of the universe. The astronomers said that the telescope was actually seeing a phenomenon known as a gravitational lens, which occurs when the gravitational field of a massive object bends light rays from a more distant source. They regarded the ability to discern in detail the structure of the distant magnified object as a major breakthrough in observing techniques. (*W Post*, Oct 9/92; *UPI*, Oct 8/92; *NY Times*, Oct 9/92; NASA Release 92-87 and 92-168)

- NASA's Pioneer 12 spacecraft fell out of radio contact with Earth as the

craft, dipping lower and lower with each orbit, faced the prospect of a slow and fiery death in Venus' atmosphere during the next few days. Launched in 1978 on a radar-mapping mission planned to last only 15 months, the craft worked nearly perfectly for 14 years, using radar to make a crude topographic map of 93 percent of Venus' surface. (*AP*, Oct 9/92; *UPI*, Oct 8/92; *W Times*, Oct 9/92; *The Sun*, Oct 9/92)

- NASA announced that astronomers using a new NASA satellite had detected a powerful, exotic object 2 billion light-years beyond the Milky Way Galaxy. The radiation source was observed by the Extreme Ultraviolet Explorer Spacecraft launched on June 7. (NASA Release 92-169)

- David Williamson, Jr., 62, retired Assistant Administrator for Special Projects with NASA, died at his home in Bethesda, Maryland. (*W Post*, Oct 9/92)

October 9: In a speech to the Society of Hispanic Professional Engineers in Los Angeles, NASA Administrator Daniel S. Goldin said NASA was committed to building a culturally diverse workforce as it pursued the exploration of space. (NASA Release 92-170)

October 10: The Argentine weather service reported that the outer edge of the "ozone hole" has shifted for the first time to a populated island in Tierra del Fuego off the southern tip of the South American mainland. Data from NASA's Total Ozone Mapping Spectrometer on the Nimbus 7 satellite confirmed that the area of depleted ozone extended for some 8.9 million square miles over the south polar region, an increase of about 15 percent from 1991, the largest ozone hole ever observed. (*W Times*, Oct 11/92; *AvWk*, Oct 12/92; *P Inq*, Oct 16/92; *AP*, Oct 16/92)

October 12: Astronomers resumed the search for evidence of extraterrestrial intelligence (SETI) today with simultaneous commands to computers and radio telescopes at Arecibo, Puerto Rico, and in the Mojave Desert of California. Although there have been previous limited projects, NASA officials, who are financing and directing the new project, said the planned 10-year, \$100 million search would be the most comprehensive and ambitious one ever undertaken to search for signals of life beyond Earth's galaxy. Later, more radio telescopes around the world were to join the search, which NASA has renamed the High Resolution Microwave Survey. The latest SETI project was timed to begin on the 500th anniversary of Columbus' discovery of land in the Americas. (*NY Times*, Oct 6/92, Oct 13/92; *W Post*, Oct 5/92; *LA Times*, Oct 7/92; *The Sun*, Oct 8/92; *Newsweek*, Oct 12/92; *AP*, Oct 10/92, Oct 12/92; *UPI*, Oct 13/92; *C Trib*, Oct 10/92; *P Inq*, Oct 10/92; 13/92; NASA Release 92-160)

- A group of NASA scientists sampling the air over southern Africa found massive pollution usually associated with the industrial centers of the Northern

Hemisphere. Most of the pollution is caused by peasant farmers burning huge tracts of scrub brush to clear their land for planting. The group arrived in southern Africa in early October after studying a virtually identical problem in Brazil. Together, the pollution from the two regions was thought to be changing the atmosphere throughout the Southern Hemisphere. Some 180 scientists from 13 countries were involved in what was considered the most detailed atmospheric study ever made of the South Atlantic. (AP, Oct 12/92; AvWk, Oct 12/92)

- A Defense Science Board review of the National Aerospace Plane ruled against building the single-stage-to-orbit vehicle in the near future, citing persistent technology shortfalls. (AvWk, Oct 12/92)

- The U.S. National Research Council urged NASA to expand study of advanced subsonic aircraft in order to keep U.S. aerospace companies competitive in the face of growing advances made by foreign industry. A council report said NASA should focus on improving aircraft performance and operating efficiency and coordinate the work with industry and academia. (AvWk, Oct 12/92; National Research Council News Report, Fall Report)

October 13: NASA officials reported that a 41-year-old Alaskan hunter was rescued thanks to a distress signal picked up by a Russian satellite and relayed to the U.S. Air Force and search teams. The hunter carried a tiny experimental emergency transmitter that may eventually become available for widespread use by campers, hunters, and other outdoorsmen. The international satellite-aided search and rescue system started 10 years ago and includes Canada, France, Russia, and the United States. (NASA Release 92-171; UPI, Oct 13/92)

- NASA's Jet Propulsion Laboratory in Pasadena was added to the Federal Superfund list of the Nation's most dangerous dump sites because toxic solvents used 40 years ago during research on liquid rocket propellants had leaked into ground water. (LA Times, Oct 14/92; AP, Oct 14/92)

October 15: NASA Administrator Daniel S. Goldin announced a series of structural changes at NASA to improve management and to bring focus to programs that are essential to the Nation's space effort. The changes affected divisions dealing with the Space Station Freedom, Science and Technology, Earth and Planetary Science, Aeronautics, and Russian Programs. (NASA Release 92-172; Space News, Nov 2-8/92; Science, Oct 23/92)

- The Air Force test-fired a new booster for the Titan IV rocket and said it was the second successful test since an explosion ruined a firing last year. The new booster would allow Titan IVs, which launch U.S. spy satellites, to carry heavier payloads. (AP Oct 16/92)

- NASA officials said that the last scheduled U.S. shuttle flight this year, a

military mission by Discovery, probably would be delayed because of a faulty component in the orbital maneuvering system. A December 2 launch date was subsequently planned. (AP, Oct 15/92; *NY Times*, Oct 16/92; *W Times*, Oct 16/92; AP, Nov 2/92)

- The International Astronomical Union for the first time issued a warning of a potential collision between Earth and a comet, in this case Comet Swift-Tuttle. The date of a potential collision is more than a century away, and the odds of a collision about one in 10,000. (*NY Times*, Oct 27/92; *C Trib*, Oct 31/92; *NY Times*, Nov 3/92; *W Post*, Nov 4/92)

October 16: Space Center Houston opened on this date. The \$70 million non-profit center, which expected to lure two million visitors a year, is designed to bring the "wonder days" of the early space program to a generation of children that has known only the Space Shuttle. The Center, on the periphery of NASA's space campus, supplants the former visitor facility inside the Lyndon B. Johnson Space Center. (*USA Today*, Oct 14/92; *H Chron*, Oct 14/92, Oct 16/92; AP, Oct 16/92; *Newsweek*, Oct 26/92; *The Sun*, Oct 25/92)

- Orbital Sciences Corporation of Fairfax, Virginia, suffered another failure of one of its rockets. Ground controllers blew up the rocket about seven minutes into its flight at Wake Island in the Pacific Ocean, conducted as part of the Pentagon's "Brilliant Pebbles" program. (*W Post*, Nov 4/92)

October 19: NASA announced that Dr. Chiaki Mukai of the Japanese National Space Development Agency had been designated as the prime payload specialist for the second International Microgravity Laboratory mission scheduled for launch aboard the Space Shuttle Columbia in July 1994. She was to be the first Japanese woman to take part in a U.S. space shuttle mission. Dr. Jean-Jacques Favier, a scientist with the French Atomic Energy Commission, was selected as an alternate payload specialist. (NASA Release 92-173; *UPI*, Oct 20/92)

- NASA's inspector general, Bill Colvin, said that an investigation had been going on for nearly two years as to whether the Perkin-Elmer Corporation of Danbury, Connecticut, maker of the flawed mirrors of the Hubble Space Telescope, withheld data that would have revealed focusing problems before Hubble was sent aloft. (*The Sun*, Oct 20/92; *WSJ*, Oct 20/92)

- Democratic vice presidential candidate Albert Gore criticized the Bush Administration for misdirecting the national space program before an audience at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Gore said that the administration had failed to establish strategic priorities and that, under President Bush, NASA had found itself working on too many programs with too little money. He pledged that a Bill Clinton administration would

seek to spend \$35 billion by the end of the decade to build an orbiting space station, in part to replace jobs lost in military industries. (*The Sun*, Oct 20/92; *NY Times*, Oct 20/92; *Prince Georges Journal*, Oct 21/92; *W. Post*, Oct 20/92)

- The countdown began for the launching of the Space Shuttle Columbia on a research and satellite delivery mission. (*NY Times*, Oct 20/92; *UPI*, Oct 20/92; *NY Times*, Oct 22/92; *UPI*, Oct 22/92)

October 20: NASA Acting Deputy Director Aaron Cohen announced that IBM Federal Systems Company, Houston; and Honeywell, Inc., Space and Strategic Systems Operations, Clearwater, Florida; were the recipients of NASA's Quality and Excellence Award. The announcement came at the Ninth Annual NASA/Contractors Conference on Quality and Productivity in Pasadena, California. (NASA Release 92-178)

October 21: During Space Shuttle Columbia's upcoming mission, scientists planned to test a theory which may have applications ranging from hurricane dynamics to superconductivity. The Lambda-Point Experiment was to study the strange behavior of helium at its critical temperature of 2.177 degrees above absolute zero. Other experiments were to study the effects of gravity on metals and semiconductors as they solidify on Earth and in orbit and vibrations in the Shuttle as the vibrations affect the other two experiments. The Shuttle crew was also scheduled to deploy the Laser Geodynamics Satellite, an Italian satellite to study the movements of the Earth's crust and other phenomena. (NASA Releases 92-175 and 92-176; *LA Times*, Oct 2/92)

- NASA chose 29 supercomputing research proposals that the agency hoped would lead to a revolution in the way scientists study the Earth and space. The goal was to achieve computational capabilities far beyond those of today's machines, enabling researchers to produce realistic simulations of phenomena such as the interaction of Earth's oceans, air, and land masses and reconstructions of the evolution of stars, galaxies, and the universe.
- NASA researchers found unexpectedly high productivity of microscopic plants near the equator in the Pacific Ocean during a recent airborne study aimed at increasing understanding of these plants in the region. The plants, called phytoplankton, play an important role in the absorption of carbon dioxide from the atmosphere. (NASA Release 92-179)
- NASA scientists tapped into a 300-year-old lead coffin in St. Mary's City, Maryland, in a search for air free of man-made pollutants. Samples of such air was expected to aid in understanding ozone damage in the present-day atmosphere. Tests on this and other coffins also helped NASA scientists evaluate the effectiveness of a tool that examines metal for tiny cracks or corrosion that occur in aircraft or spacecraft. (*USA Today*, Oct 21/92)

- NASA-sponsored research into the biological effects of space flight at the University of Wisconsin suggested that astronauts may have to workout in space to protect their bones on long-duration flights. Dr. Arthur Vailas of the university's Biodynamics Laboratory based his conclusions on the metabolic processes in the bones of rats that had experienced days of weightlessness aboard the Space Shuttle. (*UPI*, Oct 21/92)

- U.S. Rep. Louis Stokes, who criticized NASA hiring policies as racially discriminatory during congressional debate in July, said that he was encouraged by recent steps toward diversification discussed by the space agency at a gathering of top NASA officials at a mostly Black elementary school in Cleveland. The gathering included a visit by Black astronaut Charles Bolden. (*The Plain Dealer*, Oct 22/92)

October 22: The Space Shuttle Columbia blasted into space under control of a five-man, one-woman crew. In command was James Wetherbee of the Navy; his co-pilot was Capt. Michael Baker. Mission specialists were Capt. William Shepherd of the Navy, flight engineer; Charles Lacy Veach; Tamara Jernigan; and Canadian researcher Steven MacLean. On board were commercially sponsored experiments that were to examine a potential treatment for osteoporosis, material crystals to increase the speed of computers, protein crystals to determine the molecular structure of "alfa-2b interferon" used in the treatment of some cancers, and experiments on microgravity effects on astronauts. (NASA Release 92-180; *P Inq*, Oct 22/92; *UPI*, Oct 22/92; *AP*, Oct 22/92; *P Inq*, Oct 23/92; *NY Times*, Oct 23/92; Oct 25/92; *W Times*, Oct 23/92; *USA Today*, Oct 23/92; *AP*, Oct 23/92; *CSM*, Oct 23/92; *LA Times*, Oct 23/92; *The Sun*, Oct 23/92; *C Trib*, Oct 23/92)

- A Japanese scientist, Eiichi Yamaguchi, a senior research scientist at Nippon Telegraph and Telephone Corporation, said that he had observed "cold" nuclear fusion five times since the beginning of August. Much about his claim remained unclear, however. (*The Sun*, Oct 23/92)

- The "Brilliant Pebbles" missile-defense system suffered a new setback when the test of an experimental rocket was aborted 55 seconds after launch. It was the second failure in three experimental launches. (*W Post*, Oct 25/92)

October 23: NASA signed an agreement with the National Institute on Deafness and Other Communication Disorders, NIDCD, to expand biomedical cooperation between the two agencies. The agreement was intended to be the beginning of NASA's cooperation with various institutes within the National Institutes of Health. The major goal of this collaboration was the enhancing of basic knowledge and understanding of vestibular function in both normal and clinical states. (NASA Release 92-182)

- Astronomer Duncan Steel of the Anglo-Australian Observatory in Sydney warned of a possible collision between the Earth and Comet Swift-Tuttle in the year 2116. Several years would be needed to track the comet to determine its orbit with accuracy and to decide whether or not a collision is likely. (*The Sun*, Oct 26/92; *W Times*, Oct 27/92)

October 24: Shuttle Columbia astronauts carried out experiments designed to ease reentry from space. They pedalled furiously on a stationary bicycle and floated in a depressurization sack to draw blood from the top of the body to the legs. They also grabbed an aluminum panel with the Shuttle's arm and swung it about the spacecraft's cargo bay to test a Canadian robotic vision system. A day earlier, they deployed the Lageos II geodynamics satellite. (*NY Times*, (Oct 25/92; *W Post*, Oct 25/92; *P Inq* Oct 24/92; *The Sun*, Oct 25/92)

- Two NASA workshops held during the past year produced a recommendation that a multi-governmental effort be undertaken to detect dangerous asteroids using a worldwide network of telescopes at a cost of \$50 million. The second workshop examined methods for deflecting or destroying asteroids. The chance of a catastrophic collision in the average person's lifetime is quite small—about 1 in 10,000, the scientists said. (*USA Weekend*, Oct 23-25/92)

October 26: On the fourth day of their mission, Shuttle Columbia's astronauts measured ozone in Earth's upper atmosphere and tested a new toilet. The flight was scheduled to last ten days. (*W Post*, Oct 26/92; *P Inq*, Oct 26/92; *The Sun*, Oct 26/92; *USA Today*, Oct 26/92; *W. Times*, Oct 26/92; *AP*, Oct 25/92, Oct 26/92; *UPI*, Oct 26/92)

- A physicist at the University of Maryland, Richard L. Greene, developed a type of microscope that utilizes superconducting wire that is supersensitive to magnetic fields. Known to physicists as Superconducting Quantum Interference Devices, the superconducting filaments in the microscope zero in on magnetic fields with great accuracy when passed over an object. The technology has medical, military, and industrial applications. (*The Sun*, Oct. 26/92)

- Pratt & Whitney said that it had agreed to market rocket propulsion systems in the United States made by Russia's NPO Energomash, including the RD-170 rocket engine. NPO Energomash engines placed into orbit all of the space vehicles launched by the former Soviet Union. (*NY Times*, Oct 27/92; *AP*, Oct 27/92; *Washington Technology*, Nov 5/92)

October 27: Geologists at NASA's Jet Propulsion Laboratory and at Louisiana State University announced that they had discovered several previously unknown earthquake faults in California's northeastern Mojave Desert by

analyzing remote sensing images at optical, infrared, and radar wavelengths. At a meeting of the Geological Society of America in Cincinnati, JPL's Dr. John Ford outlined how spaceborne imaging technology has helped scientists find these newly observed faults. (NASA Release 92-186; AP Oct 27/92)

October 28: NASA announced that Charles F. Bolden, Jr. Col., USMC, would command Space Shuttle mission STS-60 in November 1993. Other crew members would be Pilot Kenneth S. Reightler, Jr.; and mission specialists Franklin R. Chang-Diaz; Jan Davis, Ronald M. Sega, and a Russian cosmonaut yet to be designated. (NASA Release 92-188; *Space News*, Nov 2-8/92)

October 29: NASA announced that Dr. Martin J. Fettman of Colorado State University's College of Veterinary Medicine would be the prime payload specialist for the second Spacelab Life Sciences mission scheduled for launch in August 1993. Previously named crew members consist of Commander John Blaha; Pilot Richard Searfoss; Payload Commander Rhea Seddon; and Mission Specialists William S. McArthur, Jr.; Shannon Lucid; and David Wolf. (NASA Release 92-190)

- NASA announced that the Space Station Freedom program had initiated a new effort to reduce dramatically the time it would take to integrate small experiments on the Space Station. Called EXPRESS for Expedited Processing of Experiments to Space Station, NASA engineers hoped to reduce the time it takes to get a small payload flown aboard Freedom from up to five years to less than one. (NASA Release 92-191)

October 30: NASA and the Environmental Protection Agency (EPA) signed an agreement to broaden cooperation between the two agencies. The agreement addresses environmental research, pollution monitoring, and other activities where the research capabilities of NASA can support EPA's mission to protect the environment. (NASA Release 92-192)

- The Inter-Agency Consultative Group for Space Science announced in Washington, DC, that scientists from the United States, Japan, Russia, and Europe were mounting a coordinated, multi-mission effort in solar-terrestrial science during the next four years. The effort began with the launch of Japan's Geotail satellite in July 1992 and was to continue with the 1993 launch of NASA's WIND spacecraft and missions from Russia in 1993 and Europe in 1995. NASA's Interplanetary Monitoring Platform and Japan's AKEBONO spacecraft were to provide important data as well. (NASA Release 92-193)

- The Pontifical Academy of Sciences of the Roman Catholic Church admitted in Rome that clerical judges erred in 1633 when they condemned the

Italian mathematician and astronomer Galileo Galilei for propagating the notion that the Earth revolves around the Sun. (*P Inq*, Nov 1/92)

- NASA astronomers at Kitt Peak National Observatory announced that they had observed what they believed to be a galaxy in the process of forming. They estimated that the galaxy is more than 10 billion light years distant. (*W Times*, Nov 1/92; *NY Times*, Nov 3/92; *AP*, Nov 11/92)

November

November 1: Space Shuttle Columbia landed at Cape Canaveral, ending a 10-day journey during which the crew released a laser-reflecting satellite and tested a robotic eye. (*NY Times*, Nov 2/92; *P Inq*, Nov 2/92; *W Post*, Nov 2/92; *W Times*, Nov 2/92; *AP*, Nov 2/92; *UPI*, Nov 2/92; *The Sun*, Nov 2/92)

- Rockwell's Space Systems Division and NPO Energia announced that they had signed a contract that was the first step in building docking hardware for a U.S. Space Shuttle/Russian Mir Space Station mission planned for 1995. (*AvWk*, Nov 2/92)
- Planetary scientists at NASA's Jet Propulsion Laboratory and at California Institute of Technology recently reported that they had found water ice on the planet Mercury. Radar beams aimed at both of the planet's poles bore telltale signs of having bounced off of frozen surfaces. (*Time*, Nov 2/92)
- The European Space Research and Technology Center at Noordwijk, the Netherlands, said it would use a new robotics center to support planning for the European Space Agency's manned space operations. (*AvWk*, Nov 2/92)
- Michael Griffin, NASA Associate Administrator for Exploration, said that a new heavy-lift vehicle built from components of the Space Shuttle transportation system should be able to launch elements of Space Station Freedom at a cost comparable to that of the space shuttle. (*AvWk*, Nov 2/92)
- Japanese and Chinese researchers announced that they would study single crystals produced by semiconductors during the first joint space experiment by the two countries. (*AvWk*, Nov 2/92)
- NASA and a contractor team headed by Rockwell International said they were conducting supersonic laminar flow experiments using two General Dynamics F-16XL demonstrators on loan from the U.S. Air Force. (*AvWk*, Nov 2/92)

November 3: NASA Administrator Daniel S. Goldin announced the appointment of Dr. Charles Pellerin as Associate Deputy Administrator for Strategic Planning, John R. Dailey as Associate Deputy Administrator, and Ralph C. Thomas as Assistant Administrator for Small and Disadvantaged Business Utilization. The appointments continued management changes Goldin had instituted in recent months. (NASA Release 92-194; *Space News*, Nov 9-15)

- NASA began assembling Space Shuttle Discovery for launch in December on a mission to deploy a secret Department of Defense satellite. *Liftoff* was

scheduled for December 2, nearly a month behind schedule because of problems with a faulty steering engine. (*P Inq*, Nov 4/92; *W Times*, Nov 4/92)

- Former NASA Administrator Richard Truly said that he would assume a new job as director of the Georgia Tech Research Institute, a branch of the Georgia Institute of Technology. (*Space News*, Nov 9-15/92)

November 5: NASA announced that an array of powerful, interconnected computers would help NASA solve some of the complex problems associated with designing aircraft propulsion systems. The Lewis Advanced Cluster Environment system at NASA's Lewis Research Center, Cleveland, is a network of 33 IBM RISC/6000 computer stations that can perform up to one billion floating point operations per second and has three billion bytes of memory, making it the world's most powerful IBM workstation cluster. (NASA Release 92-195)

- General Dynamics Corporation said its space systems unit had won a \$112.6 million Air Force contract to modify space-launch facilities at Vandenberg Air Force Base in California. (*WSJ*, Nov 6/92)
- NASA Administrator Daniel S. Goldin agreed to seek increased funding for NASA's life sciences program destined for the Space Station Freedom, calling current funding levels "disgraceful" and clearly in need of increased funding. (*Space News*, Nov 9-15/92)

November 6: NASA's Tethered Satellite System Investigative Board released its report, presenting the panel's finding on problems which had prevented full deployment of the satellite during Space Shuttle mission STS-46. The report identified causes for four of five problems that occurred and made recommendations for actions to prevent similar occurrences in the future. (NASA Release 92-196; *UPI*, Nov 6/92)

- A task group looking into issues concerning future satellite rescue and repair said NASA should continue to perform such missions but only when they "produce genuine benefits to U.S. interests in view of the inherent risks to the Shuttle and its crew." The task force also recommended that NASA should charge higher fees for the risky and expensive work of retrieving commercial satellites with the Space Shuttle. (NASA Release 92-197; *The Sun*, Nov 7/92; *AP*, Nov. 6/92; *W Post*, Nov 7/92; *Space News*, Nov 16-22/92)
- NASA scientists at the Jet Propulsion Laboratory and the U.S. Geological Survey in a published paper said that Mars was once very active tectonically and may still be shaken by quakes daily. The scientists said that although the planet is less seismically active than the Earth, their studies, based on Viking photos, predict that about two marsquakes of magnitude five or greater occur

per year, and about a hundred quakes of magnitude three or greater occur per year. (NASA Release 92-198; *LA Times*, Nov 6/92; *W Times*, Nov 7/92; *P Inq*, Nov 26/92)

- An article in the *Chicago Tribune* discussed the Soviet Space Shuttle Buran; built in the early 1980s, the Buran flew only once in November 1988. Today all three models of the spacecraft sit idle, victims of the economic downsizing in Russia. The Buran program seems destined for oblivion. (*C Trib*, Nov 8/92)

- Radio astronomers meeting in Sydney, Australia, said that stray radio signals from manmade sources were spilling over into the radio bands set aside for radio and space research, swamping and threatening the reception of extremely weak radio signals from space. (*C Trib*, Nov 8/92)

November 9: NASA announced that it would help sponsor the third national technology transfer conference and exposition in Baltimore December 1-3, 1992. TECHNOLOGY 2002 was scheduled to highlight leading-edge technologies from NASA and other Federal agencies which U.S. industry could use to develop new or improved products and processes. (NASA Release 92-199)

- Teledyne Industries paid a record \$17.5 million in criminal fines for falsifying tests on electronic relay switches used in high-tech weapons and spacecraft, including the Space Shuttle. Teledyne pleaded guilty to 35 criminal counts. (*W Times*, Nov 10/92; *WSJ*, Nov 10/92; *USA Today*, Nov 10/92; *AP*, Nov 9/92; *UPI*, Nov 9/92)

- A report for the Aerospace Industries Association said U.S. aerospace manufacturers would cut at least 78,000 jobs in 1992 and that sales would decline for the first time in more than 20 years. (*W Post*, Nov 10/92).

November 10: Scientists from NASA and the National Science Foundation detailed experimental projects scheduled to be undertaken in the winter in Antarctica. The Antarctic Space Analog Program was to use the harsh, frigid conditions of the Antarctic continent to test technology and techniques for future missions to the Moon and Mars. (NASA Release 92-200)

- European, Canadian, and Finnish ministers, meeting in Granada, Spain, approved spending cuts for the European Space Agency of about 13 percent through the year 2000—down to \$26 billion. The biggest cuts will affect the Hermes Space Shuttle. The ministers also launched a three-year study of ways to work with Russia on future space missions. (*WSJ*, Nov 11/92)

- NASA Administrator Daniel S. Goldin told a meeting of the Washington Space Business Roundtable in Washington, DC, that the U.S. government should spin off more new technology to help boost the economy. He also said

that the space business sector must move beyond its attempts to sell goods and services to the government to become a real commercial industry. Goldin said NASA's newly created Office of Advanced Concepts and Technology would be given broad authority to pursue innovative ideas, seek out new technologies, and accelerate transfer of the Agency's own breakthroughs to industry. (*Space News*, Nov 16-22/92; *AvWk*, Nov 16/92)

November 12: NASA Administrator Daniel S. Goldin announced that Paul F. Holloway, in addition to his responsibilities as Director of Langley Research Center in Hampton, Virginia, would be assigned temporarily to NASA Headquarters as a Special Assistant to the Administrator. Goldin also announced the departure of Don G. Bush, Assistant Administrator for Procurement, effective January 11, 1993. (NASA Release 92-292)

November 13: NASA announced that the Hubble Space Telescope had revealed a chain of luminous knots in the core of the most distant known galaxy—one that existed in the infancy of the universe and is located more than 10 billion light-years from Earth. The new photos, taken with the telescope's wide field and planetary camera, reveal detail 10 times better than photographs previously taken with ground-based telescopes. (NASA Release 92-203; *W Times*, Nov 14/92)

- A team of American and British astronomers detected the flare of a supernova almost halfway to the edge of the known universe—five billion light-years away, the most distant such supernova ever observed. Light from the supernova was expected to help astronomers grapple with the questions of whether the universe is infinite and will expand forever or whether it is finite and will eventually slow down and collapse. (*NY Times*, Nov 15/92)

- NASA announced the selection of 321 research proposals for immediate negotiation of Phase I contracts under the Agency's 1992 Small Business Innovation Research Program. The program aims to stimulate technological innovation in the United States by using small business to help meet Federal research and development needs and to encourage commercial applications of federally supported research innovations. (NASA Release 92-204)

- Jan H. Oort, 92, whose discoveries on the origins of comets and the movement of the Milky Way made him one of the 20th century's leading astronomers, died in Leiden, Holland, in early November. (*W Times*, Nov 13/92; *P Inq*, Nov 13/92)

November 16: NASA said that it was collaborating with Cray Research, Inc., of Eagan, Minnesota, to conduct joint research and development activities using the company's Cray T3D supercomputer. NASA scientists at the Jet Propulsion Laboratory expected to use the T3D system for applications that

require high-power computers, such as turning planetary data from spacecraft into three-dimensional animations and analyzing Earth satellite data. (NASA Release 92-205; *NY Times*, Nov 17/92; *WSJ*, Nov 17/92; *W Post*, Nov 17/92)

- At the Asia-Pacific International Space Year Conference in Tokyo, Russian cosmonaut Vladimir Shatalov called for strengthened space monitoring to determine compliance of major military powers with strategic nuclear arms reduction treaties. Shatalov said such collaboration in space also would help uncover possible efforts by smaller countries to develop nuclear weapons. Japan announced a plan to allow Southeast Asian countries to use a module that will be built onto the future international space station for scientific experiments in orbit. (*UPI*, Nov 16/92)

November 17: NASA said the Advanced Communications Technology Satellite Conference '92, co-sponsored by NASA, Comsat Laboratories, Harris Corporation, and Mitre Corporation, scheduled for November 18-19 in Washington, DC, would focus on pioneering communications technology developments to provide better service, lower cost, greater convenience, and improved reliability. The conference marked another of NASA's partnerships with industry in developing advanced technologies that create new markets and commercial applications. (NASA Release 92-206)

- In a carefully hedged report, the General Accounting Office said that crucial American high-technology industries including consumer electronics and robotics may have lost ground in the 1980s to foreign competitors, particularly Japan. The sectors examined were: semi-conductors, semiconductor equipment, supercomputers, pharmaceuticals, telecommunications, fiber optics, robotics, consumer electronics, civilian aircraft, advanced materials, and flexible manufacturing systems. (*NY Times*, Nov 18/92; *LA Times*, Nov 18/92)

- NASA and McDonnell-Douglas announced completion of negotiations of a cost-plus-award-fee contract to provide continuation of Spacelab integration activities. The amount of the contract was \$163 million, with four one-year options of \$34.6 million, \$29.7 million, \$28.6 million, and \$27.3 million. (NASA Release C92-19)

- NASA Administrator Daniel S. Goldin said that he would act promptly to implement the recommendations of a Management Review Team for enhanced security at the Ames Research Center in Moffett Field, California. The team considered Ames high risk for hostile intelligence operations. (NASA Release 92-207; *UPI*, Nov 18/92; *LA Times*, Nov 19/92; *USA Today*, Nov 19/92; *W Times*, Nov 19/92; *P Inq*, Nov 19/92; *AP*, Nov 18/92, 19/92, and 20/92; *W. Post*, Nov 20/92; *NY Times*, Nov 22/92; *Space News*, Nov 23-29/92)

- NASA Administrator Daniel S. Goldin, speaking at the University of Hartford, Connecticut, said spending on space exploration was an investment

in the future, but that the nation's space agency must get more for its money than it had in the past. NASA research has economic benefits for the Nation, providing jobs and developing technologies with commercial applications, but just as important is the Agency's role in supporting exploration that increases knowledge of the universe and provides hope for a better future, Goldin added. (Hartford Courant, Nov 18/92)

November 18: Lockheed Corporation's Space Operations Company unit won the competition for a \$200-million-a-year contract to manage the Kennedy Space Center in Cocoa Beach, Florida. NASA said the contract would run for an initial period of four years, plus three two-year options, for a total potential contract period of 10 years. Its estimated value over the 10-year period was \$1.9 billion. (WSJ, Nov 19/92; W Post, Nov 19/92; Fla Today, Nov 19/92)

- A recent General Accounting Office comprehensive audit of NASA's financial management charged that NASA's internal controls and financial management systems had failed to ensure efficient expenditure of taxpayers' money. According to the report, NASA's fiscal 1991 year-end reports contained more than \$500 million in errors. (Antelope Valley Press, Nov 18/92)

November 19: Walter Jaffe of the Leiden Observatory in the Netherlands said that the Hubble Space Telescope had captured the most detailed view yet of an immense caldron of heat, violence, and energy surrounding what might be called a "black hole," a celestial object 10 million times more massive than the Sun. Astronomers said the photograph provided powerful support for the theory of "black holes" by showing several of the features predicted to surround them. The galaxy belongs to the Virgo Cluster of galaxies about 45 million light-years from Earth. (W Times, Nov 20/92; USA Today, Nov 20/92; NY Times, Nov 20/92; W Post, Nov 20/92; P Inq, Nov 20/92; LA Times, Nov 20/92; AP, Nov 20/92; UPI, Nov 20/92;)

- NASA set a December 2 launch date for the year's eighth and last Shuttle flight, a military mission, designated STS-53. Five astronauts, all military men, will release a classified satellite, thought to be a Lacrosse radar-imaging satellite from the Shuttle Discovery. Crew members are David Walker, commander; Robert Cabana, co-pilot; James Voss, Guion Bluford, and Michael Richard Clifford. (W Times, Nov 20/92; UPI, Nov 19/92; UPI, Nov 30/92)

- A panel of experts recommended that the Air Force assume sole responsibility for developing a new all-purpose national launch system called the "Spacelifter" by the end of the decade. NASA's fleet of Shuttles would be phased out at the earliest opportunity, having become too costly and fragile a system to dominate the space program much longer. The report did not call for a large, heavy-lift vehicle but focused instead on development of lower-

cost, medium-size rockets that could satisfy virtually all known payload needs and be tailored to carry cargo or people. (*W Post*, Nov 19/92 and Nov 21/92; *USA Today*, Nov 20/92; *NY Times*, Nov 20/92; *LA Times*, Nov 20/92; *P Inq*, Nov 20/92 and Nov 22/92; *AP*, Nov 20/92; *UPI*, Nov 19/92)

November 21: NASA launched a small satellite on a \$19 million mission to help the Pentagon develop its strategic missile detection system. A Scout rocket lifted the Miniature Seeker Technology Integration-1 satellite into orbit. The satellite carried miniaturized cameras and sensors designed to detect an attack by medium-and short-range missiles. (*W Times*, Nov 23/92; *W Post*, Nov 23/92; *AP*, Nov 21/92; *P Inq*, Nov 22/92)

November 22: A Russian space capsule containing a cut-glass replica of the Statue of Liberty and greetings from Russian President Boris N. Yeltsin splashed down in the Pacific Ocean off Washington state. The Resource 500 satellite was billed as Russia's first private space launch and honored the 500th anniversary of the voyage of Columbus in 1492. (*The Sun*, Nov 23/92; *P Inq*, Nov 23/92 and Nov 25/92; *W Times*, Nov 23/92; *W Post*, Nov 23/92; *USA Today*, Nov 23/92; *UPI*, Nov 23/92; *LA Times*, Nov 25/92)

November 23: Responding to evidence that Earth's protective ozone layer is thinning or disappearing faster than was forecast, environmental officials from 81 countries met in Copenhagen to consider revising the Montreal Protocol on the control of substances that attack ozone. The main point of the meeting, sponsored by the United Nations Environment Program, was to set a timetable for the phaseout of chlorofluorocarbons, halons, and carbon tetrachloride. (*The Sun*, Nov 22/92;

- General Electric said that it had agreed to sell its aerospace business to defense giant Martin Marietta for \$3 billion. The deal would take General Electric out of the defense business and make Martin Marietta the world's largest aerospace electronics company. (*USA Today*, Nov 24/92; *WSJ*, Nov 24/92; *W Post*, Nov 24/92; *NY Times*, Nov 24/92; *W Times*, Nov 24/92)

November 25: The National Technology Transfer Center announced that it had launched the Strategic Partnership Initiative to fund proposals with matching awards of up to \$200,000 for the purpose of fostering new and productive technology transfer and commercialization partnerships between Federal laboratories and U.S. industry, research universities, and State and local non-profit organizations. (NASA Release 92-209)

- With just over three years left before construction of Space Station Freedom begins in Earth orbit, NASA announced that it would add spacewalks to upcoming Shuttle flights when possible, beginning with one during STS-54 in January 1993. (NASA Release 92-210)

- Meeting in Copenhagen, the United Nations environmental conference agreed to phase out some ozone-destroying gases by the end of 1995, four years ahead of a previous deadline. Delegates agreed to phase-out chlorofluorocarbons by 1995 instead of 1999 and to eliminate halons by 1994, six years ahead of a previous deadline, and methyl chloroform by 1996 instead of 2005. (*W Post*, Nov 26/92; *The Sun*, Nov 26/92)

November 29: The countdown for the December 2 launch of the Shuttle Discovery began, the 10th and allegedly the last Shuttle mission dedicated to U.S. Department of Defense work. Aside from releasing a secret military satellite, astronauts were to conduct a number of military experiments, such as testing a Shuttle laser system and releasing of metal balls to be tracked by space debris researchers. (*The Sun*, Nov 29/92; *W Post*, Nov 28/92 and Nov 29/92; *W Times*, Nov 28/92; Nov 29/92, and Nov 30/92; *CSM*, Nov 27/92; *P Inq*, Nov 30/92; *USA Today*, Nov 30/92; *UPI*, Nov 30/92)

- Scientists prepared to decide whether Dante, a walking robot, would make a descent next month into an active Antarctic volcano. The project had two goals: testing the prototype robot for possible Mars missions, and getting a rare look at the minerals and gases ejected by the 12,000-foot icebound volcano. Scientists also wanted to learn about the permanent lava lake that bubbles and boils on the crater's floor. NASA, along with the National Science Foundation, was funding the \$2 million project. (*The Sun*, Nov 29/92; *W Post*, Nov 29/92; *P Inq*, Nov 18/92)

November 30: NASA and NPO-Energia, a Russian company, planned to meet during the next two weeks for a final review on the feasibility of using the Soyuz TM spacecraft as an Assured Crew Return Vehicle for astronauts aboard the Space Station. The Soyuz spacecraft was one of various concepts being considered for use as a return vehicle. (NASA Release 92-212)

- In a broad-ranging interview, NASA Administrator Daniel S. Goldin said that he expected to deal with declining Agency budgets by prioritizing and focusing NASA projects. He estimated that a substantial cut had been made in the Agency's costs during a review of the last few months—perhaps one-third to one-half of a needed \$17 billion in savings—and that new programs would not be multi-billion-dollar projects but would cost in the range of tens to hundreds of millions of dollars. (*Aerospace America*, Nov 92)

December

December 1: NASA astronomers announced that the Hubble Space Telescope had caught a clear glimpse of more than 300 galaxies clustered four billion light-years away, giving astronomers their first detailed view of galactic structure at a time when the solar system was just beginning. The Hubble images revealed that star-forming galaxies were far more prevalent in the clusters of the younger universe than in modern clusters of galaxies near us today. The findings have important implications for theories of how galaxies have evolved and are continuing to evolve at an apparently rapid rate. The observations also may have uncovered the most distant cluster of galaxies yet seen at a distance of 10 billion light-years, two-thirds of the way back to the presumed origin of the universe. (NASA Release 92-213; *NY Times*, Dec 2/92; *LA Times*, Dec 2/92; *W Post*, Dec 2/92; *The Sun*, Dec 2/92; *USA Today*, Dec 2/92; *UPI*, Dec 2/92)

- NASA announced plans to consolidate some management functions for the Space Station Freedom program and to create a contractor-led integration team to ensure the successful building and deployment of the international Space Station. The consolidations affected operations in Reston, Virginia, and at the Johnson Space Center in Houston, Texas. The consolidation came amid charges of cost growth and delays at Johnson Space Center and among the center's team of contractors led by McDonnell Douglas. The problems associated with the \$5 billion contract had prompted two audits and one investigation by NASA's inspector general. (NASA Release 92-214; *W Post*, Dec 2/92; *Space News*, Dec 7-13/92; *AvWk*, Dec 7/92)

- The Technology 2002 conference, sponsored by NASA, opened in Baltimore to display the wares of Federal agencies and private companies that had developed products they hoped to sell or license for use in new products. The conference was billed as a way for entrepreneurs and companies to look over the latest innovations coming out of Federal laboratories. Equally important, the conference was a way for the Federal government to find practical uses for the technology that had been developed with billions of dollars of taxpayers' money. (*The Sun*, Dec 23/92)

- NASA scientists held the first news conference broadcast live from the southern polar region. The broadcast via satellite to NASA Ames Research Center in Moffett Field, California, meant that Antarctica researchers would be able to talk with the outside world through electronic means instead of ham radios. More importantly, NASA Ames scientists hoped to use the hookup to employ special technology—"virtual reality" technology—to control remote exploration vehicles probing Antarctica's ice-covered lakes. Scientists hoped to study lake sediments because they might contain life forms similar to ones that might have existed at one time on Mars. In the future, sci-

entists hope to use "virtual reality" technology for Martian exploration. (*Peninsula Times Tribune*, Dec 2/92; *San Jose Mercury News*, Dec 2/92)

December 2: NASA and several other U.S. and Canadian agencies announced selection of an international team of more than 200 scientists to study the relationships between northern forests and the atmosphere and how those relationships affect the global environment. The study, the Boreal Ecosystem-Atmosphere Study, was intended to conduct ground-based, air-borne, and satellite measurements in a four-year, \$30-million program. NASA's component is part of Mission to Planet Earth, the Agency's long-term effort to study the Earth as a global environmental system. (NASA Release 92-215)

- Space Shuttle Discovery lifted off on a secret mission for the Pentagon, carrying what analysts surmised was a spy satellite to monitor troop movements in Eastern Europe, Asia, and the Middle East. Several days of technology and medical experiments were also scheduled for the week-long mission. The launch was delayed 85 minutes while the Sun melted a thick coat of ice from its fuel tank. This eighth and last Shuttle mission of 1992, the 52nd for NASA's program, concluded NASA's busiest year since 1985, when nine Shuttles flew. It was also the last to carry a classified military cargo.

The crew consisted of Shuttle Commander David Walker, a Navy captain; Pilot Robert Cabana, a Marine colonel; Guion Bluford, Jr., an Air Force colonel in charge of the satellite; James Voss, an Army lieutenant-colonel, and Michael Clifford, an Army lieutenant-colonel in charge of releasing six metal balls that space debris researchers on the ground were to track radar and telescopes. (*The Sun*, Dec 3/92; *P Inq*, Dec 3/92; *NY Times*, Dec 3/92; *W Post*, Dec 3/92; *LA Times*, Dec 3/92; *WSJ*, Dec 3/92; *USA Today*, Dec 3/92; *AP*, Dec 2/92, Dec 3/92; *UPI*, Dec 3/92)

- Astronomers associated with several major observatories in the United States raised concerns anew about light pollution from cities and highways. Astronomers have long said that artificial light threatens their ability to study the heavens from Earth, but some are also saying that the glare threatens everyone's view. The scientists' campaign to curb light pollution has gained a wider audience as non-astronomers have realized that shading lights can save money as well as heavenly views. Efforts to curb excessive light pollution have improved astronomical viewing at such major observatories as Kitt Peak in Arizona. (*W Times*, Dec 2/92)

- At the annual meeting of the American Astronautical Society in San Francisco, California, NASA Administrator Daniel S. Goldin said that NASA should decide within five years whether to replace the Space Shuttle after 2005. A decision in the matter should be made by 1997, Goldin said, although in any event, the space agency would continue to fly the Shuttles

until at least 2005. Shuttle costs would have to come down in the meantime, however, even as safety improvements continued. (*Space News*, Dec 7-13/92)

December 3: NASA Chief Daniel S. Goldin promised a bolder, "new" NASA that would control costs on its scientific missions in space and support the research and development efforts of domestic aircraft makers. Goldin's promise came at a NASA town meeting at California State University, Dominguez Hills campus, where several hundred people showed up for an opportunity to question Goldin about overpriced components, underfunded programs, and a lack of direction in the nation's space program. It was the fourth town meeting Goldin had hosted around the country since taking over as NASA's Chief Administrator in April. (*LA Times*, Dec 9/92)

- In a real sign that the "space race" between Russia and the United States was over, the director of the Russian Space Agency, Yuri Koptev, was taken on a tour of the Jet Propulsion Laboratory in Pasadena, California. Koptev was in southern California to familiarize himself with the U.S. space program and to develop contacts with local aerospace companies. The United States and Russia already had plans to cooperate on two unmanned missions to Mars, and American space officials were discussing the possibility of using the Russian Soyuz spacecraft as a lifeboat in space for astronauts aboard Space Station Freedom. (*Star-News*, Dec 4/92)

December 4: NASA sent its remote-controlled robot named "Dante" to Antarctica, where it was scheduled to explore the active volcano Erebus. The \$2 million mission was intended to use Antarctica to test possible Mars-bound technology because the harsh climate is as close to that of Mars as occurs naturally on Earth. Upcoming U.S. missions to Mars were expected to land small robots programmed to look around, take samples, and perhaps begin mapping the planet, all tasks "Dante" would test in Antarctica. (*WSJ*, Dec 8/92; *NY Times*, Dec 8/92)

- In the last of a week-long series of talks at the California Institute of Technology in Pasadena, NASA Administrator Daniel S. Goldin said NASA, its partners, and its contractors, were suffering from a bureaucratic "sickness" and political infighting that had sapped the U.S. civilian space program's will to take risks or to admit mistakes. "We need a complete resurgence of our space program to be bold, to take risks, and accept failure," Goldin said during a lively, two-hour discussion and debate with Carl Sagan, astronomer and founding president of the Planetary Society, based in Pasadena. Sagan agreed that NASA had lost its "sense of direction" and said that the key questions facing NASA were what would be its role in the post-Cold War era and what could it accomplish that was in the national interest in a time of pressing economic problems. (*Space News*, Dec 14-20/92)

December 5: Paul Beaver, editor of the military affairs magazine *Jane's Defense Weekly*, said in an interview that the U.S. Air Force was operating a new generation of secret spy planes capable of reaching eight times the speed of sound. Code-named "Aurora," the plane was believed to operate at night and to incorporate the latest radar-evading technology. Pentagon officials denied that such an aircraft existed or was contemplated. For years, some scientists and aviation fans had speculated that a successor to the famed SR-71 "Blackbird" spy plane was under development and testing. (*The Sun*, Dec 6/92; *W Post*, Dec 12/92)

- Astronomers protested plans by the American military to launch a satellite carrying a Russian nuclear reactor in a test for the "Star Wars" antimissile defense system. The astronomers said radiation from the reactor could disrupt operations of several important present and future science missions in space, as had happened in the past with Soviet nuclear-powered satellites. The scientists were seeking the support of NASA in trying to halt or modify the test flight. (*NY Times*, Dec 6/92; *W Post*, Dec 6/92; *C Trib*, Dec 6/92)

December 6: After four days of trying, laser signals beamed up from Florida were received aboard the Shuttle *Discovery*. That success came a day after NASA had decided to cancel a major experiment in tracking space debris because of a dead battery aboard the Shuttle. (*NY Times*, Dec. 7/92; *The Sun*, Dec 7/92; *USA Today*, Dec 7/92; *AP*, Dec 7/92; *UPI*, Dec 5/92; *W Post*, Dec 7/92; *NY Times*, Dec 8/92)

December 7: The asteroid *Toutatis* passed within about 2.2 million miles of Earth on its orbit around the Sun, the closest an object of that size is known to scientists to have come to Earth. *Toutatis* is about one to two miles wide, large enough to survive passage through the atmosphere and crash into Earth's surface, potentially causing major ecological and human disaster. (*W Post*, Dec 8/92; *The Sun*, Dec 8/92)

- The U.S. Air Force said that budget realities had necessitated cuts in plans to have the National Aerospace Plane reach orbit and fly 25 times the speed of sound. The experimental hypersonic craft's top speed was likely to be cut from Mach 25 to Mach 12 or Mach 15 and its runway-to-space approach might be abandoned in favor of launch from the back of another airplane. Cost was projected to drop from \$10 billion to \$3 billion. (*W Times*, Dec 9/92)

December 8: NASA's *Galileo* spacecraft flew by the Earth at 10:09 a. m. EST, completing a three-year gravity-assist program and setting course to reach Jupiter in December 1995. The spacecraft was programmed to measure the near-Earth environment and to observe Earth and the Moon during this flyby. (NASA Release 92-217; *UPI*, Dec 2/92, Dec 7/92, Dec 8/92; Dec 9/92; *AP*, Dec 1/92, Dec 8/92; *NY Times*, Dec 8/92; *W Post*, Dec 9/92; *WP*, Dec 9/92)

- Veteran NASA astronauts Richard O. Covey and Kenneth Bowersox, along with ESA astronaut Claude Nicollier, were named to the crew for STS-61, the Hubble Space Shuttle Telescope servicing mission scheduled for late 1993. Covey was appointed the mission commander, and Bowersox was to be the pilot. Nicollier was named to be a mission specialist. Three other crew members previously named to the STS-61 mission were Payload Commander Story Musgrave, and Mission Specialists Tom Akers, Jeffrey A. Hoffman, and Kathryn D. Thornton. (NASA Release 92-218)
- NASA officials used satellite photos to make a video showing how the ground moved along fault lines during California's strongest earthquake in decades on June 28. Shown at the American Geophysical Union's fall meeting in San Francisco, California, the video showed how Mojave Desert faults moved during the magnitude-7.5 Landers earthquake. This was the first time fault motion has been observed by using images from space. Other NASA scientists presented evidence on the theory of plate tectonics. Extremely accurate laser, satellite, and other measuring devices have detected what appear to be tectonic movements as small as one-eighth of an inch a year. (WP, Dec 8/92; LA Times, Dec 9/92)
- The U.S. Department of Energy and the Mayak Production Association of the Russian Ministry of Atomic Energy signed a contract by which the Energy Department would buy Russian-produced plutonium-238 for use as a power source in U.S. spacecraft. The contract provided for the United States to purchase up to 40 kilograms (88 pounds) over five years. The plutonium is not weapons-grade and is to be used by NASA to power unmanned space missions that are being planned. (WSJ, Dec 29/92; W Post, Dec 29/92)

December 9: NASA Administrator Daniel S. Goldin issued a call to restore America's leadership in aeronautics that is threatened by failure to invest adequately in research facilities and advanced technology. Goldin told the American Institute of Aeronautics and Astronautics meeting in Arlington, Virginia, that additional spending had to be directed to high speed research, advanced subsonic and systems integration, critical research facilities, and hypersonic research. Top priority needed to be given to developing a hypersonic commercial plane that could carry 300 passengers at least 6,000 miles nonstop at two-and-one-half times the speed of sound by the year 2005. NASA's budget provided for \$1.1 billion for aeronautics, or 7.9 percent, Goldin said, a funding level that had to increase. (NASA Release 92-219; The Sun, Dec 10/92; LA Times, Dec 10/92; H Post, Dec 10/92; AvWk, Dec 14-21/92)

- McDonnell Douglas Space Systems Company was awarded a three-year extension of its existing contract for payload ground operations services, valued at approximately \$561.4 million, at the Kennedy Space Center in Florida. (NASA Release C92-21)

- Space Shuttle Discovery landed at Edwards Air Force Base in California because of bad weather at Cape Canaveral, Florida. Astronauts had to wait more than two hours before debarking because of toxic fumes from a leaking thruster. The main mission, the deployment of a secret Pentagon satellite, occurred soon after launch in what was the last Shuttle mission for the U.S. military. The day before, the Shuttle had to swerve in orbit to avoid a four-inch piece of space junk, the third such incident in two years. (*The Sun*, Dec 10/92; *AP*, Dec 9/92, Dec 10/92; *UPI*, Dec 9/92, Dec 10/92; *W Post*, Dec 10/92; *NY Times*, Dec 10/92; *WSJ*, Dec 10/92; *P Inq*, Dec 10/92; *LA Times*, Dec 13/92; *USA Today*, Dec 10/92; *W Times*, Dec 11/92)

- Two American scientists presented a new theory on the evolution of Earth's continents and on early mass extinctions of life. Michael Rampino of New York University and Verne Oberbeck, a geologist at NASA's Ames Research Center in Moffett Field, California, discussed evidence that suggests that a huge asteroid struck Earth 250 million years ago, helping break up a super land mass called Gondwanaland and contributing to Earth's worst mass extinction of life forms. The new theory, presented during the American Geophysical Union's fall meeting in San Francisco, was met by disbelief and skepticism, even by scientists who believe there is overwhelming evidence that another later asteroid impact wiped out the dinosaurs and other species by disrupting Earth's climate 65 million years ago. (*P Inq*, Dec 10/92; *The Sun*, Dec 10/92; *W Post*, Dec 10/92; *AP*, Dec 10/92; *W Times*, Dec 20/92)

- Scientists with the National Oceanic and Atmospheric Administration said that the ozone hole over the Antarctic that has formed annually since 1987 had closed up again after setting records for depleting Earth's protective ozone layer. After falling from October 12 to December 5, ozone levels rose above the levels considered to be a "hole" on December 6. The hole formed earlier and lasted longer this year than ever before, the scientists said. (*UPI*, Dec 10/92)

December 10: Britain, Germany, Italy, and Spain agreed today to produce a less expensive version of Europe's most ambitious defense-industry project, the European Fighter Aircraft. Defense ministers from the four countries approved plans for a new fighter that was to cost 30 percent less than the original plane, projected at \$38 billion. Flight tests were expected to begin next year, with the new plane in service in 2000. (*NY Times*, Dec 11/92)

- NASA scientists at the American Geophysical Union's fall meeting in San Francisco said that a NASA satellite had provided overwhelming evidence that industrial pollutants were responsible for the hole in Earth's protective ozone layer above Antarctica. The Upper Atmosphere Research Satellite, launched in 1991, also had produced evidence that the Antarctic ozone hole may act as a "sink," sucking in and destroying ozone from much of the Southern Hemisphere. (*AP*, Dec 10/92)

December 11: NASA's Cassini mission to Saturn passed a major milestone with the completion of a project-wide critical design review. The review included a comprehensive examination of the mission and spacecraft. (NASA Release 92-222)

- The Russian Space Agency announced plans for three piloted missions and six Progress flights in 1993. The first mission of the series was scheduled for January 24, 1993. (*Itar-Tass*, Dec 11/92)

- Air Force Secretary Donald Rice voiced strong support for designing a National Aerospace Plane capable of flying into orbit. Rice's statement came in response to news reports about plans to lower the aerospace plane programs' goals in response to congressional concerns about the cost of the program. France and Russia were also reported to be working jointly to develop aerospace-plane type engines that could threaten America's leadership in the field. Known as the X-30, the plane would be the world's first single-stage-to-orbit vehicle. (*Antelope Valley News*, Dec 19/92)

December 14: NASA announced that scientists from the Ames Research Center, Moffett Field, California, and across the United States would participate in a Russian biomedical space mission later this month. The Cosmos '92 "biosatellite" was to be an unpiloted, recoverable spacecraft that carried plant and animal experiments. Cosmos '92 would become the eighth Russian biosatellite mission in which NASA had participated. (NASA Release 92-223)

- Researchers at NASA's Ames Research Center in Moffett Field, California, said that they would take part in a Russian biomedical space mission. Ames scientists expected to use monkeys to study the effect of lengthy space travel on bones, eyes, and inner ear receptors. The space mission would involve experiments from several nations and was expected to be launched December 29. (*UPI*, Dec 14/92)

December 15: NASA officials said that the Galileo spacecraft and its atmospheric probe had passed the half-way mark on their voyage to Jupiter. The first full test results on November 20 and December 2 since launch three years ago showed that the probe's systems were in good working order. Galileo was scheduled to arrive at Jupiter in early December 1995. A major milestone in space communications was achieved recently when NASA scientists successfully transmitted laser signals to Galileo at a distance of 1.3 million miles. (NASA Releases 92-224 and 92-225; *AP*, Dec 16/92)

- In the current issue of the British journal *Nature*, two scientists, Martin I. Hoffert of New York University and Curt Covey of Lawrence Livermore National Laboratory in California, reported new findings, largely developed from geological studies, on how Earth's climate responded to changes in

atmospheric heat-trapping carbon dioxide and other influences in the distant past. Using climatic data from two periods in the past, one 20,000 years ago in the midst of the last ice age, and the other in the mid-Cretaceous period 100 million years ago, the two scientists found that if atmospheric carbon dioxide doubles from its present level, the average global climate will become about 4 degrees Fahrenheit warmer. These findings agree with computer models of climatic change. They are also compatible with earlier work by NASA scientists at the Goddard Institute for Space Studies in New York, whose climatic studies predicted that a doubling of carbon dioxide would reproduce a warming of about 5.4 degrees Fahrenheit. (*NY Times*, Dec 15/92)

December 16: NASA scientists using the Hubble Space Telescope said they had discovered extended disks of dust around 15 newly-formed stars in the Orion Nebula starbirth region 1,500 light-years away. Such disks are a prerequisite for the formation of solar systems like the Sun's. Hubble's detailed images confirm more than a century of speculation, conjecture, and theory about the genesis of solar systems. Astronomers said the Hubble data was the strongest evidence yet that planets could exist beyond the solar system and may even be a common occurrence. "We have found a place where it is very possible that there will be planets within the next few million years," said Edward Weiler, program scientist for the space telescope, at a NASA briefing. (NASA Release 92-226; *W Times*, Dec 17/92; *USA Today*, Dec 17/92; *W Post*, Dec. 17/92; *NY Times*, Dec 17/92; *LA Times*, Dec 17/92; *CSM* Dec 17/92; *The Sun*, Dec 17/92; *AP*, Dec 17/92; *UPI*, Dec 17/92; *APn*, Dec 17/92; *Newsweek*, Dec 28/92)

- In his annual speech to the Aerospace Industries Association, President Donald Fuqua predicted another year of declining production and more layoffs. "The long-term outlook for the aerospace industry is for a continued decline in overall sales volume for the rest of the decade," Mr. Fuqua told industry officials in Washington, D.C. (*The Sun*, Dec 17/92; *USA Today*, Dec 17/92; *W Post*, Dec 17/92; *AP*, Dec 16/92)

- NASA Administrator Daniel S. Goldin said that the end of the Cold War had created a new era of space cooperation with Russia and Western Europe. Goldin spoke to a public meeting at the University of Washington in Seattle. NASA intended to study the possibility of using the Soyuz capsule as a "life raft" for Space Station Freedom and might begin using some Russian booster rockets in the future, he added. At the same time, NASA would have to balance these advantages against the risks associated with such cooperation. (*Seattle Post-Intelligencer*, Dec 17/92)

- NASA continued to prepare for what it called "the most aggressive" space-shuttle mission yet—its mission to repair the Hubble Space Telescope, tentatively set for December 7, 1993. As conceived, it would require four astronauts working in

two-person shifts several days to make the repairs. They would need three or possibly four space walks to complete the work. The main task was to install a new camera and a set of corrective mirrors to compensate for spherical aberration in the main 2.4-meter mirror. These and other repairs would, NASA hoped, restore 90 to 95 percent of Hubble's design capabilities. (CSM, Dec 16/92)

December 18: NASA unveiled its high-flying, unpiloted atmospheric research aircraft called "Perseus" at Manassas, Virginia. Perseus-A is the first aircraft designed specifically for atmospheric science. It will carry up to 110 pounds of instruments to a maximum altitude of 82,000 feet and is expected to begin flying scientific missions in 1994. Perseus-A was built for NASA by Aurora Flight Services Corporation in Manassas at a cost of \$1.5 million. Company engineers expected Perseus to break the world altitude record for unmanned aircraft and the record for altitude in horizontal flight by an airplane. (NASA Release 92-227; *W Post*, Dec 19/92, Dec 28/92)

December 21: NASA hailed 1992 as a "blockbuster year" for NASA space science missions, with scientific discoveries ranging from the beginning of time to black holes to the innermost workings of the human cell. "Given the unprecedented return on science information and the robust launch record, 1992 was the most productive year in the history of space science," said Dr. Lennard A. Fisk, Associate Administrator for NASA's Office of Space Science and Applications in Washington, DC. (NASA Release 92-228)

December 22: NASA managers set January 13 as the launch date for the first Shuttle mission of 1993. Designated STS-54, the flight was to have two primary objectives—deployment of the Tracking and Data Relay Satellite (TDRS-F) and astronomical observations of invisible x-ray sources within the Milky Way Galaxy with the Diffuse X-ray Spectrometer. The crew was to be comprised of John Casper, commander; Don McMonagle, pilot; and three mission specialists, Mario Runco, Greg Harbaugh, and Susan Helms. (NASA Release N92-110; *C Trib*, Dec 23/92; *AP*, Dec 22/92; *UPI*, Dec 22/92)

- NASA scientists released pictures and results from spacecraft Galileo's December 8 flight over the Moon's north pole and 189 miles above the southern Atlantic Ocean. The flyby allowed Galileo to practice for Jupiter by studying Earth as if it were an alien planet. The craft detected radio signals that changed frequencies in a repeating, artificial way, indicating intelligent life on Earth. It also detected ice clouds in the stratosphere that help create a hole in the protective ozone layer above Antarctica and found evidence that the Moon once was more volcanically active than thought. (*AP*, Dec 22/92, 23/92; *C Trib*, Dec 23/92; *W Times*, Dec 23/92; *NY Times*, Dec 23/92; *UPI*, Dec 23/92)

- A passenger jet was flown for the first time after undergoing nearly three years of modifications that converted it into a Shuttle landing-gear test air-

craft. The modified Convair 990 was in the air for about one hour in the first of three flights planned by NASA in advance of the actual landing gear tests. (*Antelope Valley Press*, Dec 23/92)

December 23: Technicians searching for a leak in a Space Shuttle solid-fuel booster rocket found a 1-inch hair pressed into a secondary seal, a NASA spokesperson said. The leak was detected yesterday in a segment of a booster for the Shuttle Columbia, which was being prepared for a February launch date. It was a leak in an O-ring seal that was blamed for the 1986 Shuttle Challenger explosion in which seven astronauts were killed. (*W Times*, Dec 27/92; *W Post*, Dec 17/92; *The Sun*, Dec 27/92)

December 28: A group of physicists working at Fermilab near Chicago announced that they had observed a "top quark," the last of the fundamental building blocks of matter to have its existence confirmed in the laboratory. Repeat experiments to confirm the existence of the top quark were underway, but if the findings hold up, the event could become one of the most celebrated in the study of particle physics. (*B Sun*, Dec 28/92)

- NASA scientists began a new attempt to open the stuck antenna on the Galileo space probe by rotating the satellite to point the antenna toward the Sun. They hoped the warmth would expand the metal fittings and release the stuck mechanism. If this maneuver fails, they were prepared to turn the antenna's electric motors on and off at rapid intervals to "hammer" the jammed mechanism in a final bid to overpower what they believed were stuck pins and pop open the antenna. (*W Post*, Dec 26/92, Dec 29/92, Dec 30/92; *The Sun*, Dec 26/92, Dec 30/92, Dec 31/92; *USA Today*, Dec 29/92, Dec 31/92; *NY Times*, Dec 29/92, Dec 31/92; *UPI*, Dec 29/92, Dec 30/92; *AP*, Dec 28/92, Dec 29/92, Dec 30/92; *P Inq*, Dec 31/92; *W Times*, Dec 31/92)

- Lockheed Corporation formed a joint venture with Russian aerospace firm Kunichev Enterprise to market the Russian-built Proton rocket for commercial satellite launches, a move that could help make Russia one of the dominant forces in the world-wide commercial launch business. Lockheed was to be responsible for marketing the Russian rocket to Western customers and would provide payload integration. Rockets were to be launched from the Baikonur site in Kazakhstan. (*WSJ*, Dec 29/92; *LA Times*, Dec 29/92; *NY Times*, Dec 29/92)

- Russia launched a spaceship carrying insects and two monkeys into orbit to conduct radiation experiments on the creatures. Experts from the European Space Agency as well as Italian, German, and other foreign scientists were to oversee the biological experiments. The ITAR-Tass news agency also said that Cosmonauts Anatoly Solovyov and Sergei Avdeyev, who had spent five months aboard the Mir Space Station, were in good condition following routine medical examinations. (*AP*, Dec 28/92, Dec 29/92)

- Astronomers ruled out any possibility that Comet Swift-Tuttle would collide with the Earth on its next pass through the inner solar system in 2126. In October astronomers warned that the comet might hit the Earth during that pass, potentially creating a pall of dust capable of blocking sunlight, disrupting climate, and threatening human civilization. More accurate calculations of Swift-Tuttle's orbit showed that there was no chance of a collision. (*NY Times*, Dec 29/92; *The Sun*, Dec 30/92)

December 30: The eight-legged rappelling robot Dante was placed in position on the rim of the Antarctic volcano Mt. Erebus in preparation for its exploration of the interior of the crater and its lava lake. NASA and the National Science Foundation hoped that the Dante project would help develop technology and telecommunications capabilities that NASA could use in future explorations of the Moon or Mars or in ongoing research activities in the Antarctic. (NASA Dante Advisor #3; *UPI*, Dec 28/92; *AP*, Dec 28/92, Dec 31/92)



January

January 1: Fred J. Friel, a radio scientist and amateur radio operator, died of renal failure on December 24. Mr. Friel worked as a radio engineer for RCA and as an engineer for the Navy before joining NASA when that agency was created. Friel served as radio frequency spectrum manager with NASA from 1971 to 1975. He also served as an adviser to the president's Office of Telecommunications Policy. (*W Times*, Jan 1/93)

January 3: The project to send the eight-foot-high, 1,000-pound robot Dante to explore Mount Erebus, an active volcano in Antarctica, was aborted a day after the robot started down the volcano. The robot had gone about 21 feet into the volcano when a communications cable linking the machine to its control station broke. NASA scrubbed the mission after it had been determined that repairs to the damaged cable could not be made in time for the mission to be completed before severe weather set in.

- NASA said that its mission to send a robot into an Antarctic volcano had opened the way for exploration of the Moon and Mars. Despite the fact that the mission had to be aborted, David Lavery, director of the Dante project, noted that the objectives of controlling the robot from afar and testing sophisticated hardware in a harsh environment had been met.

- The \$2 million Dante project was sponsored by Carnegie-Mellon University and the New Mexico Institute of Mining and Technology. Backed by NASA and the National Science Foundation, the project was directed by NASA's Goddard Space Flight Center in Greenbelt, Maryland. (*B Sun*, Jan 1/93; Jan 2/93; AP, Jan 4/93; *NY Times*, 2/93; *W Post*, Jan 3/93; *W Times*, Jan 3/93; *WSJ*, Jan 4/93)

January 4: When asteroid Toutatis passed within 2.2 million miles of Earth in December, NASA took 100 times more detailed radar images of it than had ever been taken of that kind of object before. According to astronomer Steven Ostro, "This is our first clear look at one of the many thousands of asteroids whose orbits can intersect Earth's orbit." The images show asteroid Toutatis comprises two big chunks of rock, probably held in contact by gravity. One chunk has an average width of about 2.5 miles; the other is about 1.6 miles wide. Toutatis is "among the 50 largest Earth-approaching asteroids that we estimate to exit," Mr. Ostro said. NASA bounced radar waves off the asteroid using a 230-wide antenna dish at a tracking station in the California Mojave Desert. (*B Sun*, Jan 4/93; *NY Times*, Jan 4/93; *W Post*, Jan 4/93; *USA Today*, Jan 4/93; AP, Jan 4/93)

- The Navy announced that it was turning over the Moffett Field Naval Air Station, located 40 miles south of San Francisco, California, to NASA's Ames Research Center, which is located on the base. The Center was to continue

developing and testing space and aircraft-related technologies. The Center's wind tunnels, flight simulators, and other facilities have helped produce and test generations of spacecraft and commercial aircraft, including the Space Shuttle. (AP, Jan 4/93)

- Studies on the feasibility of using Soyuz TM spacecraft as crew return vehicles for the U.S./International Space Station were scheduled to enter a more detailed phase according to NASA Associate Administrator Arnold D. Aldrich. NPO ENERGIA was to study modifications, launch options, and costs for one year. The Soviet hardware could allow NASA to permanently staff the station by 1998 or 1999. (AvWk, Jan 4/1993)

- *Florida Today* reported that NASA was launching a new type of air-launched Pegasus rocket that activates only after being released from the wing of an aircraft. The winged vehicle, which was developed by Orbital Sciences Corporation, has a solid-fuel rocket that gives it the ability to put small satellites into orbit at a bargain price. Plans called for the Pegasus to carry a Brazilian remote sensing satellite. (Fl Today, Jan 4/93)

January 5: Vice President Dan Quayle's space policy advisory board released a report stating that "The U.S. government's organization of space activities is not appropriate for the post-Cold War era." The report noted that space bureaucracy must be simplified and centralized and that more technology must be shared between government and industry. It also called U.S. space launch capabilities inefficient and unsafe. (W Post, Jan 5/93; Space News, Jan 5/93)

- NASA's new Shuttle toilet, the Improved Waste Collection System (IWCS), was slated for its first space-flight test later this month. The IWCS, which is designed to accommodate long-term flights, has "basically unlimited capacity" because of its innovative method of compacting solid waste and use of a modular removal container. The device's \$30 million price tag brought criticism from government auditors. (W Post, Jan 5/93; USA Today, Jan 6/93; AP, Feb 13/93)

- Satcon Technology Corporation (SATCON) entered into an agreement with Advanced Medical Systems Inc. (AMS) for the joint development of cardiovascular medical devices. SATCON was using its active motion control technology to develop these devices. This technology was developed as part of the Department of Defense and NASA's SBIR program; the program was established by Congress to provide money to U.S. small businesses to develop innovative products with high commercial potential. (AP, Jan 5/93)

- Astronomers have discovered a huge concentration of mysterious "dark matter," which scientists believe may make up as much as 95 percent of the universe. The finding was the first to "indicate that there may be enough

material to close the universe," said the research team's Richard F. Mushotzky of NASA's Goddard Space Flight Center in Greenbelt, Maryland. In a closed universe, the expansion of the universe, which is being slowed by the pull of gravity, would come to a halt or nearly so. The discovery was detected by the international ROSAT x-ray satellite observatory. ROSAT, an acronym for Roentgen Satellite, is a joint project of Germany, the United States, and the United Kingdom. It was launched on a Delta II rocket from the Cape Canaveral Air Force Station, Florida, on June 1, 1990. (NASA Release 93-1; *W Post*, Jan 5/93; *W Post*, Jan 8/93; *B Sun*, Jan 5/93, Jan 8/93; *NY Times*, Jan 5/93; *Arizona Republic*, Jan 5/93; *P Inq*, Jan 8/93; *Newsweek*, Jan 18)

- Shortly after Space Shuttle Endeavour's launch later this month, technicians and engineers from GTE Government Systems Corporation were to establish an almost continuous communications link with the Shuttle. The space link to Earth would come through a system of tracking and data relay satellites (TDRS), which would be supplemented by a satellite carried by Endeavour. (*Business Wire*, Jan 5, 93).

- NASA announced that engineer Karl Anderson from the Ames-Dryden Flight Research Facility, Edwards, California, had invented a process that yields more accurate, faster stress measurements. Anderson's method uses a circuit called a "constant current loop"; the system prevents errors caused by temperature changes in the wires that link instruments, called strain gauges, to recording devices. (NASA Release 93-002; *AP*, Jan 25/93; *Antelope Valley Press*, Jan 20/93)

January 6: A team of astronomers from the University of Arizona told a meeting of the American Astronomical Society that they had found convincing new evidence that a black hole the size of a million suns is at the center of the Milky Way Galaxy. The astronomers reported that they had detected faint infrared emissions from an area at the galactic core that is the source of a powerful radio signal possibly produced by forces surrounding a black hole. The team detected the emissions by using a new adaptive optics system known as FASTTRAC, developed by graduate student Laird Close and Donald W. McCarthy Jr., of the University of Arizona. (*W Post*, Jan 6/93; *NY Times*, Jan 6/93; *USA Today*, Jan 6/93)

- NASA has chosen 38 research proposals to be incorporated into phase II of its Small Business Innovation Research Program (SBIR). The projects will be conducted by 36 small business from 18 states; the projects have a value of approximately \$19 million. NASA will select approximately 100 additional research proposals in January and February 1993.

- SBIR attempts to stimulate technological innovation in the United States by using small businesses to help federal agencies meet their research and development needs. (NASA Release 93-003)

- NASA released two new Hubble space telescope photographs that show a bullet of gas streaking across the sky. According to J. Jeff Hester, an Arizona State University astronomer, the new pictures show a “shock wave from a colossal explosion of a star 15,000 years ago smashing into a pocket of interstellar gas, heating the gas and causing it to glow.” Following the blast wave is a shaft of gas traveling at more than 3 million miles an hour. The images show the structure behind the shock waves in the Cygnus Loop supernova remnant. The Hubble photos are giving astronomers their first detailed look at the anatomy of the powerful astrophysical shock wave generated by a supernova. (NASA Release N93-002; *B Sun*, Jan 8/93; *W Post*, Jan 18/93)

- According to Neal Pellis of the University of Texas M.D. Anderson Cancer Center, a research project from the Cancer Center aboard the Space Shuttle Endeavour could provide “a big step in developing better treatments for cancer patients.” The experiment will attempt to find out more about the human immune system and why it does not work as well in long-term space travel. (*H Post*, Jan 6/93)

January 7: A rocky asteroid, rather than an icy comet, probably caused a huge explosion over Siberia in 1908 that flattened at least 40,000 trees over about 850 square miles. A research team from NASA and the University of Wisconsin used a computer simulation to determine that an asteroid measuring about 65 yards was a better explanation than the comet; the simulation revealed that comets would explode much too high in the sky to fit the projected altitude of the Tunguska blast. (*B Sun*, Jan 7/93; *NY Times*, Jan 7/93; *LA Times*, Jan 8/93; *W Post*, Jan 11/93; *P Inq*, Jan 7/93; *WP*, Jan 11/93)

- NASA Administrator Daniel S. Goldin announced that NASA was raising the number of contracts it had with small, disadvantaged, and women-owned businesses. According to Goldin, \$310 million would be set aside under a Determinations and Findings (D&F) to make sure that NASA awarded eight percent to such businesses. Eight percent was the figure set by Congress. (*LA Watts Times*, Jan 7/93)

- Russia agreed to help build a U.S. atom smasher in Waxahachie, Texas. Russian scientists would be involved in the design, engineering, and production of two of the Collider’s booster accelerators in addition to its experimental detectors. According to the terms of the agreement, which could add \$100 million to the Russian economy and save the U.S. a similar amount, Russia would provide Russian hardware at half price. (*WSJ*, Jan 7/93; *USA Today*, Jan 7/93)

- By using the Hubble Space Telescope, astronomers have concluded that the Markarian 315 Galaxy, a galaxy that has been observed for 10 years, is in reality composed of two merged galaxies; the collision of the two galax-

ies is thought to have provided new fuel for a massive black hole, which has a "tail" of gas 240,000 light-years long. (NASA Release 93-006; *W Times*, Jan 8, 1993)

- Using the Cosmic Background Explorer (COBE), NASA scientists measured thermal radiation differences across the universe and came up with more conclusive evidence than ever to support the "Big Bang" theory that the universe was created by a single blast 15 billion years ago. Measurements made by COBE revealed that 99.97 percent of the early radiant energy of the universe was released within the first year after the Big Bang itself. "This is the ultimate in tracing one's cosmic roots," said NASA scientist John C. Mather, who announced the findings at a meeting of the American Astronomical Society. (NASA Release 93-5; *USA Today*, Jan 8/93; *NY Times*, Jan 8/93; AP, Jan 8/93; *AvWk*, Jan 25/93)

- NASA released four new images gathered by the Cosmic Background Explorer. The images, which were released at the American Astronomical Society meeting in Phoenix, Arizona, showed infrared sources such as dust within the Solar System, stars in the Milky Way Galaxy, and dust and stars in other galaxies. The images were created from Diffuse Infrared Background Experiment (DIRBE) data. (NASA Release 92-256)

- Static firing tests of a propulsion development test article for Space Station Freedom began at NASA's White Sands Test Facility (WSTF) in New Mexico in late December. The tests checked the preliminary design for the propulsion module that was to be used for Space Station attitude control, orientation, speed and altitude control, and avoidance of space debris. (NASA Release 93-7)

January 8: A Utah State University group sponsored by NASA's National Space Grant College and Fellowship Program Office was scheduled to launch a high-altitude research balloon on January 11 to measure ozone distribution and wind parameters in the Earth's stratosphere. The balloon, which was to fly across the Gulf of Mexico to Florida, was the eleventh launched by this team and the first of 24-hour duration.

- Throughout the balloon's flight, teams of amateur radio operators in Texas, Louisiana, Mississippi, Alabama, and Florida were to receive information from the balloon's gondola; this information was to be relayed by high-frequency radio to the Utah State University team. Other flights of an longer duration were scheduled to be launched from Canada, the United States, Mexico, and Central America. (NASA Release 93-8)

- NASA announced that it would soon begin tests using a modified Convair 990 commercial jet airliner to expand the operational landing capabilities of the Space Shuttle system. The Convair has been undergoing modifications for

two years in preparation for tests that would help Johnson Space Center researchers better understand the operational capabilities of the Shuttle system. (*Desert Wings*, Jan 8/93)

- A General Accounting Office (GAO) report charged that NASA was very resistant to change. Some of the GAO's criticisms, including poor budgeting, contract management, and organizational culture, had also been identified as problem areas by a White House scientific panel. (*NY Times*, Jan 8/93; *USA Today*, Jan 8/93)
- A report released by NASA Administrator Daniel S. Goldin said that NASA must improve its ability to transfer technology to business. The report included eight recommendations for changing NASA's culture to facilitate technology transfer.
- The report noted that NASA's efforts were quite good in areas where technology transfer was the primary mission activity. These areas included aeronautics, the Small Business Innovative Research (SBIR) program, and the Centers for Commercial Development of Space.
- NASA created the Office of Advanced Concepts and Technology last November to better meet the needs of industry, academia, and NASA communities. Ensuring the rapid transfer of technology into the commercial sector is one of the new office's major functions. (NASA Release 93-009)

January 11: In an interview in the *Scientist*, NASA Administrator Daniel Goldin said that the current NASA reorganization would make science more of a priority in NASA and involve the science community in correcting problems at NASA. He stated, "NASA is science and exploration, not infrastructure and bureaucracy." In response to a question about jobs, he noted that NASA was not a jobs program, but rather existed for "inspiration and hope, and a basic understanding of science." He said that he hoped to launch a small discovery satellite every year, while cutting back Space Shuttle flights from 12 or 13 to six a year. (*The Scientist*, Jan 11/93; *AvWk*, Jan 25/93)

- A team of astronomers from the University of Massachusetts in Amherst and Arizona's Kitt Peak Observatory announced at a gathering of the American Astronomical Society in Phoenix that they had gotten a glimpse of hundreds of Sun-like stars shortly after the stars emerged from the clouds of dust that would have obscured their birth. The team found that many stars begin life in small, tight-knit families and at that stage are surrounded by orbiting disks of dust grains and gas. Scientists believe that this is the material from which planets like Earth are derived. (*W Post*, Jan 11/93)

January 12: NASA announced that it planned to use the eight Space Shuttle flights scheduled for 1993 for research relating to the building and operation of Space Station Freedom, scheduled to be launched in three years.

- Endeavour, scheduled for its first 1993 launch in January, was to conduct extravehicular activities involving station assembly and maintenance; a 10-hour test shut-down of one of the Shuttle electricity-generating fuel cells in order to demonstrate the capability required to certify the Shuttle for long duration stays at the Freedom; and an experiment called the Application Specific Preprogrammed Experiment Culture System (ASPECS) designed as a cell growth and maintenance device to support cell biology research and improve existing bioreactor technology.
- Columbia, a German-sponsored mission, the first Spacelab module flight of 1993, scheduled for launch in February, was scheduled to continue studies in materials and life sciences research. The Spacelab Discovery, scheduled for lift off in March, was to measure the long-term variability in the total energy radiated by the Sun and study its interaction with the Earth's atmosphere. An April Endeavour flight was to fly the first Spacelab middeck augmentation module and retrieve the European Retrievable Carrier deployed from Atlantis in August 1992. Spacehab also would carry a space station flight experiment called the Environmental Control and Life Support Systems Flight Experiment, containing two components of Freedom's environmental control system. A Discovery flight in July was scheduled to expose various materials to the space environment to help determine which materials would work best in future spacecraft design, including the space station. The Columbia, scheduled to be launched in August, was to focus on understanding how the human body reacts and adapts itself to the space flight environment.
- A November Discovery flight, the second Spacehab flight of the year, was scheduled to carry the Wake Shield Facility (WSF), designed to be released from the payload bay to create an atomic oxygen wake as it circled the Earth. Discovery astronauts would conduct experiments to determine the effect the "space wake" had on them. The December flight of Endeavour was scheduled to be the first servicing mission to the Hubble Space Telescope. (NASA Release 93-10)
- NASA appointed Deidre A. Lee as acting Associate Administrator for Procurement. She replaced Don G. Bush, who announced his intention to resign in November 1992. Since September 1991, Lee has been serving as Deputy Assistant Administrator for Procurement. Prior to that she was the executive officer to NASA's acting Deputy Administrator. (NASA Release 93-11)
- Russian scientists on the Mir spaceship were scheduled to begin an experiment that involved using a mirror to reflect sunlight down to Earth. In the

experiment, a 65-foot-diameter disk of aluminum-coated plastic film would be unfurled in space. The experiment would test the possibility of illuminating areas on the Earth with light equivalent to that of several moons. Scientists agree on the need for environmental studies to access the possible effect of such a practice. (*B Sun*, Jan 12/93; *NY Times*, Jan 12/97; *W Times*, Feb 3/93; AP, Feb 3/93; *USA Today*, Feb 4/93; *W Post*, Feb 4/93; *LA Times*, Feb 4/93)

- Researchers hoped that the lead coffins buried beneath the floor of the 17th-century Great Brick Chapel in St. Mary's City, Maryland, contained 300-year-old air. However, according to Joel Levine, the scientist who headed the team analyzing the air at NASA's Langley Research Center in Hampton, Virginia, the coffins appeared to contain modern air, as signalled by the presence of Chlorofluorocarbons, which were first manufactured in the 1940s. Scientists hoped to compare the chemistry of the old air with modern air in order to determine how much the atmosphere has been altered by industrial pollution and the burning of fossil fuels. Although disappointed that no "old air" was found in the coffins, Levine was pleased with the technology that had been developed to extract it. (*B Sun*, Jan 12/93; *P Inq*, Jan 13/93; AP Jan 12/93)

- The military's plans to test a Russian Topaz 2 nuclear reactor in orbit were criticized by the governing council of the American Astronomical Society and some other scientists. Council members were concerned because experience with previous Russian reactors had shown that they emit radiations that "can significantly disrupt x-ray and gamma-ray astronomical observations." Society officials noted that they were not opposing the mission or the use of nuclear reactors in space; rather they were asking that the test be conducted at higher levels, which would presumably be safer.

- Plans called for the Topaz 2 reactor to be put into an orbit 1,000 feet high; over the span of a year, the spacecraft housing the reactor would be lifted to 19,000 feet by an electric propulsion system powered by the reactor. The mission was projected to cost \$150 million. To stay within this budget, the Pentagon would need to use the planned Delta rocket rather than a more expensive Atlas rocket. (*NY Times*, Jan 12/93)

January 13: Crew members of a NASA booster-recovery ship waiting for the launch of the Shuttle Endeavour rescued three Cubans found floating in the ocean about 37 miles east of Cape Canaveral. The Cubans, who were floating on two large inner tubes fastened together with boards and ropes, said they had been at sea for eight days and without food and water for six days. They were heading for Miami. (*W Post*, Jan 13/93; AP Jan 12/93)

- According to reports, the planet-probing spacecraft Galileo was approaching its last pre-Jupiter target, the asteroid Ida. It was to pass about 1,500 miles from the asteroid on August 28 and was scheduled to arrive at Jupiter on December 5, 1995.

- Galileo's controllers at the California Institute of Technology's Jet Propulsion Laboratory (JPL) in Pasadena, California, continued to work on unfurling the spacecraft's stuck high-gain antenna. If their attempts were unsuccessful, the craft's controllers would use Galileo's low-gain antenna to gather data, including data from a probe that would descend into Jupiter's atmosphere. Use of the back-up system would enable NASA to complete 70 percent of its mission, according to project manager William O'Neill. (CSM, Jan 13/93)
- The three main commercial sponsors of the 52-foot Conestoga 1620 rocket scheduled to be launched this spring from Wallops Island, Virginia, were selling ad space on the shell of the rocket. The price: \$500,000 for 58 feet of space. The Conestoga launch was part of NASA's Commercial Experiment Transport program. (*P Inq*, Jan 14/93; *USA Today*, Jan 13/93; *Advertising Age*, Jan 11/93; *W Post*, Jan 26/93)
- Research recently confirmed that 65 million years ago a comet or asteroid crashed into Earth at the northern tip of what is now the Yucatan peninsula. Because dinosaurs disappeared at about the same time, researchers have speculated that there might be some connection between the impact and the dinosaurs' disappearance. However, the comet or asteroid that gouged out the crater seems to have been only one cause of the massive extinctions that occurred at the time. According to Walter Alvarez of the University of California, Berkeley, "If a single big impact and a single big extinction were the whole story, it would be clear by now. Instead we keep finding mysteries wrapped up in enigmas." (CSM, Jan 13/93)

January 14: The Space Shuttle Endeavor lifted off on the year's first Shuttle flight. During the six-day mission, crew members would conduct a variety of tasks and experiments in Earth orbit. Six hours after the Shuttle's launch from Florida's Kennedy Space Center, the crew successfully deployed the Tracking and Data Relay Satellite System (TDRSS), a network that provides communications, tracking, telemetry, data acquisition, and command services for the Space Shuttle. Crew members were also scheduled to take astronomy observations using the Diffuse X-ray Spectrometer (DXS); perform the first in a series of test spacewalks designed to refine training methods for future spacewalks, for example, the Hubble Space Telescope repair mission scheduled for later in the month; conduct a series of scientific experiments covering a wide range of disciplines; and test a new Shuttle toilet, which has unlimited capacity and is intended to accommodate crews on future lengthy space missions. The crew was also scheduled to use toys to demonstrate physics principles in a TV broadcast to four elementary schools in crew members' hometowns and to take part in the national bell-ringing ceremony marking President-elect Bill Clinton's inauguration. (NASA Release 93-004; *P Inq*, Jan 11/93; *B Sun*,

Jan 10/93, Jan 11/93, Jan 14/93, Jan 18/93; *USA Today*, Jan 11/93, Jan 13/93, Jan 14/93, Jan 18/93, Jan 19/93; *W Times*, Jan 11/93, Jan 14/93; AP, Jan 11/93, Jan 12/93, Jan 13/93, Jan 14/93, Jan 19/93; *W Post*, Jan 14/93; UPI, Jan 11/93, Jan 13/93; *LA Times*, Jan 14/93, Jan 17/93, Jan 18/93; *NY Times*, Jan 12/93, Jan 14/93, Jan 17/93, Jan 18/93; *WSJ*, Jan 14/93; *P Inq*, Jan 14/93; *W Times*, Jan 18/93; *USA Today*, Jan 18/93; UPI, Jan 19/93; *AvWk*, Jan 25/93)

- Courtney Stadd, acting Deputy Associate Administrator for the Office of Advanced Concepts and Technology at NASA, was given the job of designing an effective commercialization office at the Agency. His office was commissioned to work on space commercialization, engineering analysis, technology development, and tech transfer. (*Washington Technology*, Jan 14/93)

- In his final report on U.S. space policy, Vice President Dan Quayle warned that the planned Space Station Freedom would not survive unless NASA stuck to its current budget and schedule. In his report, he also urged replacement of the Shuttle fleet by different launch systems. The report called for a more cost-effective and efficient method of sending humans into space to be developed by 2005; urged that no more than five years elapse between approval and launch of future science programs; and supported international partnerships in space with the caveat that such transactions should not endanger our economic and security interests. (AP, Jan 14/93; *W Post*, Jan 15/93; *USA Today*, Jan 29/93)

- A NASA in-house study reported that the agency's technology transfer reputation had been overblown. According to the assessment, "Technology transfer processes are non-integrated, undocumented, and too slow." The report was requested last May by NASA Administrator Daniel S. Goldin. (*Washington Technology*, Jan 14/93)

- A panel of government scientists announced that volcanic eruptions had made the last half-year the fifth coldest on record in the United States. The year would have been the coldest since 1958 worldwide had not a surprisingly strong El Niño brought warming effects. The eruptions may also have increased the ozone hole over the Antarctic, the scientists reported. (*W Post*, Jan 14/93; *NY Times*, Mar 9/93)

January 15: An x-ray spectrometer aboard the Space Shuttle Endeavour malfunctioned while scanning the space between stars. Controllers at NASA's Goddard Space Flight Center in Greenbelt, Maryland were attempting to correct the problem. The spectrometer measures low-energy x-rays emitted from the space between stars. Using this device, scientists hoped to prove or disprove the theory that a bubble of hot gas in the Milky Way Galaxy was produced by a nearby exploding star. Meanwhile, Endeavour crew members conducted medical tests and started 28 biological tests; they also prepared for their elementary school classroom presentation called "Physics of Toys." (*NY Times*, Jan 15/93; AP, Jan 15/93)

- According to Luke Dones, a visiting assistant research astronomer at NASA's Ames Research Center, Moffett Field, California, the Earth's rotation rate may be caused by early collisions with rocks as large as Mars. Without the large impacts, the Earth would rotate only every 200 hours instead of the 24 hours it rotates today, said Dones. (NASA Release 93-012; AP, Jan 14/93; *NY Times*, Jan 19/93)

- David L. Akin and a team at the University of Maryland's Space Systems Laboratory were working on developing a data base on how to operate robots in space. The process involved testing robots in a 50-foot-deep, \$1.7 million Neutral Buoyancy Research Tank indoor pool. By testing the robots in the simulated weightlessness of the tank, scientists could learn which would work best in outer space. The Space Systems Laboratory was funded by NASA. (*B Sun*, Jan 15/93)

- Included in the promises Bill Clinton made during his presidential campaign were two relating to NASA. Clinton promised to create a civilian research agency to serve as a means of transferring new technologies into new products. He also promised to support construction of Space Station Freedom. (AP, Jan 15/93)

January 18: On December 23, Bill Clinton picked John H. Gibbons, head of the Congressional Office of Technology Assessment, to be his science and technology advisor. Gibbons planned to emphasize civilian-sector competitiveness; he also hoped to broaden industry's input into White House policy making while making sure that companies invested serious money into government-backed projects. (*Bus Wk*, Jan 18/93)

- The National Oceanic & Atmospheric Administration's Space Environment Services Center in Boulder, Colorado, prepared software that allowed scientists to state the level of confidence they had in their weather predictions. Such software allowed utilities to better gauge when to start back-up power that would make outages caused by stormy weather less harmful. (*Bus Wk*, Jan 18/93)

January 19: NASA scientists at Goddard Space Flight Center, Greenbelt, Maryland, reported that depletion of stratospheric ozone over Antarctica in 1992 was as severe as in any previous year. Ozone is destroyed by chlorofluorocarbons, or CFCs, which are used as solvents, propellants, and coolants. On September 23, 1992, the surface area of the ozone hole reached 8.9 million square miles. Measurements were taken by the Nimbus-7 and Meteor-3 Total Ozone Mapping Spectrometer (TOMS) instruments. (NASA Release 93-14; UPI, Jan 19/93)

- Astrophysicists reported that data from an x-ray spectrometer aboard the Space Shuttle Endeavour might have come from a million-degree gas pro-

duced by a nearby and fairly recent supernova, or exploding star. Scientists have puzzled over these x-rays for 25 years. Wilton T. Sanders from the University of Wisconsin commented, "There's a lot more analysis that needs to be done before we can start pinning down the exact origin of these x-rays. At this point, we're just very happy with the results that we're getting. The x-rays do seem to clearly be from a thermal process." (*W Times*, Jan 19/93; *B Sun*, Jan 19/93; NASA Release, Jan 21/93)

January 20: The Shuttle Endeavour and its crew of five landed January 19 at Kennedy Space Center in Florida. Endeavour circled Earth 96 times and traveled 2,501,277 miles during its six-day flight. The Shuttle and its five crew members were said to be in good shape. (*LA Times*, Jan 20/93; *W Times*, Jan 20/93; *NY Times*, Jan 20/93; *B Sun*, Jan 20/93)

- Vice President Dan Quayle, head of the National Space Council, presented Thomas P. Stafford, a retired Air Force lieutenant general and former astronaut, with the Congressional Space Medal of Honor "for exceptional meritorious efforts and contributions to the welfare of the Nation and mankind." Stafford flew in space in the 1960s—twice aboard the two-man Gemini, once on an Apollo flight around the Moon, and once in a rendezvous and docking of the Apollo capsule with a Soviet Soyuz spacecraft. (AP, Jan 20/93)

- NASA Administrator Daniel S. Goldin volunteered to remain at NASA until the Clinton administration appointed a replacement. He made the offer in a January 14 letter to the White House. Meanwhile, he suspended an agency reorganization that he had just begun following months of review. White House officials have just begun to collect names of potential NASA chiefs and solicit opinions on Goldin's record, according to government officials. (*W Post*, Jan 20/93; *Space News*, Jan 25-31)

- Germany's space agency was scheduled to be in charge of the scientific aspect of Shuttle Columbia's next research mission. NASA would oversee Shuttle operations during the flight. Ninety-three experiments were planned, two-thirds sponsored by German institutions and the rest by other European countries, the United States, and Japan. This would only be the second time in 32 years of American manned spaceflight that a mission had been managed from outside the United States. (AP, Jan 20/93)

January 21: NASA announced that it had been unable to repair the Galileo spaceship's main antenna, which had failed to open despite repeated attempts to fix it. The problem left the craft disabled for its 1995-96 Jupiter exploration.

- NASA said that it expected to complete 70 percent of the Galileo mission even if it were forced to rely solely on the spaceship's small antenna. (*W Times*, Jan 21/93; *NY Times*, Jan 21/93; *USA Today*, Jan 21/93; *W Post*, Jan 21/93; *WP*, Jan 21/93; *AP*, Jan 21/93)

January 22: Scientists at the Massachusetts Institute of Technology (MIT) and NASA reported that water that evaporates on the equator flows towards the Earth's poles in airborne "rivers" of vapor that can equal the volume in the Amazon. Reginald E. Newell of MIT said that researchers were trying to determine how and why these atmospheric rivers occurred and what role, if any, they played in cyclones and other phenomena. The rivers were discovered using data collected in 1984 and 1991 by NASA's Measurement of Atmospheric Pollution by Satellite program and analyzed by the European Center for Medium-Range Weather Forecasts. (*LA Times*, Jan 22/93; *B Sun*, Jan 22/93; *AP*, Jan 22/93; *W Post*, Jan 25/93; *NY Times*, Jan 26/93)

- NASA contracted with Stanford University to do additional work on the Gravity Probe-B experiment. The experiment tests predictions of the general theory of relativity. Gravity Probe-B determines how space and time are warped by the presence of the Earth and its rotation by measuring small changes in the spin of four gyroscopes in a satellite at 400 miles altitude in a Earth polar orbit. The first Shuttle test flight was scheduled for October 1995. (NASA Release C93-b)

- Officials at the University of California, Berkeley, announced that a violent overnight wind storm had destroyed a multimillion-dollar radio telescope. The 85-foot diameter dish, which was built in 1962, was located at the Hat Creek Observatory in the Lassen National Forest 70 miles northeast of Redding. NASA used the dish as part of its Crustal Dynamics Program, which measures motion of plates that compose the Earth's crust. (UPI, Jan 22/93)

- The government-backed computer chip consortium Sematech announced Thursday that it had produced chips with electrical devices just 0.35 microns wide using American production equipment. The announcement indicated that the American chip industry was coming back on track technically. The state-of-the-art in chip production was 0.6 microns; however, Japanese companies recently began demonstrating their ability to produce 0.35 chips. Achieving 0.35 micron capabilities by the end of 1992 was one of Sematech's goals at its founding in 1987. (*LA Times*, Jan 22/93)

- The European Space Agency in the Netherlands invented new shoes for astronauts to use in orbit. The new shoes, which look like ordinary sneakers, have small suction cups on the bottom of each shoe. The suction cups grip floor, wall, and ceiling and allow the astronauts to walk around in the weightless Shuttle. Up until now, in order to get around astronauts have had to stick their feet into loops placed around the Shuttle. (AP, Jan 22/93)

- Outgoing Energy Secretary James D. Watkins conceded in a letter to the chairman of the House Science, Space, and Technology Committee that foreign governments probably would not pick up much of the cost of the \$8.2 bil-

lion Superconducting Super Collider (SCC), which is under construction near Waxahachie, Texas. The project would consist of a 54-mile tunnel through which subatomic particles would be hurled against each other at nearly the speed of light in an attempt to discern the nature of matter. The SCC, which was supported by many of the Nation's scientists, was vulnerable because it had no immediately practical application. (AP, Jan 22/93)

January 23: McDonnell Douglas Corporation, the Nation's largest defense contractor, announced that it planned to cut 10 percent of its work force, including 4,000 to 5,000 jobs at its commercial aircraft unit in Long Beach, California. As of the end of 1991, the company's employment numbers had fallen by 27 percent, or about 21,700 jobs. (*W Times*, Jan 23/93; *NY Times*, Jan 23/93; *WSJ*, Jan 25/93)

- The Martin Marietta Corporation announced that it had delayed completing its pending acquisition of the General Electric's Aerospace division; the delay was caused in part by government antitrust concerns. The sale would double Martin Marietta's size. (*NY Times*, Jan 23/93)

- A spaceship, with two cosmonauts on board, was launched from Kazakhstan to test a new docking procedure for a possible linkup with a U.S. Space Shuttle. The spaceship was scheduled to dock with the orbiting Space Station Mir and deliver the two cosmonauts, who would replace the two currently on board the Mir. (*W Times*, Jan 23/93; AP, Jan 24/93; UPI, Jan 24/93)

January 25: Researchers have turned their military projects to commercial and other uses, and experts say that the real winner would be the economy. At Georgia Tech, scientists converted a project that involved using a laser to help fighter pilots see the enemy through icy clouds to a project that uses lasers to help weather forecasters measure ozone. Agencies like NASA and the Energy Department now supply 20 percent of the \$380 million budget at Lincoln Laboratories in Bedford, Massachusetts; the laboratory once worked only for the Defense Department. (AP, Jan 25/93)

- Louis Williams, Director of High-Speed Research for NASA, lectured at NASA's Langley Research Center about an environmentally safe, economically sound supersonic transport (SST) that is within the Nation's technological reach. The plane, which would ferry 300 people across the Pacific Ocean in four hours, would go twice as fast as the Concord and carry three times as many people. Government research on the project began in 1990 and was scheduled to run another two years; early research focused on the project's environmental goals, which Williams maintained were being met. The Federal government gave \$450 million to the project.

The aerospace industry appeared to be somewhat skeptical of the project because of its high costs and the number of technical breakthroughs needed to

get the project off the ground. Some estimates placed the cost of developing the SST at around \$15 billion, as opposed to the \$4 billion cost associated with developing a conventional plane. (*Newport News Daily Press*, Jan 25/93)

January 26: Daniel J. Jones, 80, a senior aeronautical engineer who retired in 1973 after 20 years with the Army Material Command, died January 23 after a heart attack. He served in the Navy from 1941 to 1953, and had tours of duty with the naval Aviation Engineering Division in the South Pacific during World War II and with the Naval Bureau of Aeronautics in Washington during the Korean War. (*W Post*, Jan 26/93)

- Rockwell International Corporation Chairman and CEO Donald R. Beall presented the Chairman's Team Award to National AeroSpace Plane engineers in recognition of the Engine Flowpath Team's significant contributions to hypersonic propulsion development in the United States. The team was composed of 11 engineers from General Dynamics, McDonnell Douglas, Pratt & Whitney, Rockwell's Rocketdyne and North American Aircraft businesses, and NASA's Langley Research Center. (*Antelope Valley Press*, Jan 26/93)

- Rockwell International Corporation, based in Seal Beach, California, announced that it had agreed to pay \$225 million for Sundstrand Corporation's Data Control subsidiary. Rockwell would merge the subsidiary, which makes flight-control systems and instruments, into its Collins avionics division, which makes communications, navigation, flight control, and position location gear. (*WSJ*, Jan 26/93)

- Loral Corporation's Loral Vought Systems unit announced that Japan had agreed to buy a multiple-launch rocket system. The four-year contract was for \$250 million. The agreement included 1,300 tactical and practice rockets, 47 launcher trainer pods, and 36 launchers for the ground-to-ground defense system. (*WSJ*, Jan 26/93)

- A White House panel recently called for the American space program to cut back its program significantly. The panel's report, issued on December 17, said that duplication among agencies had to be eliminated and cold-war secrecy reduced. The panel added that the United States should seek to make international cooperation an essential component of its space exploration strategy. (*NY Times*, Jan 26/93)

- At a recent meeting in St. Louis, astrophysicists discussed the mystery of blasts of gamma rays that appear every few days from somewhere, but never from the same place. After reviewing new satellite observations and discussing various theories, experts could not even determine where the gamma ray bursters, as they are called, were coming from.

Speculation continued, however. A survey by the Compton Gamma Ray Observatory, an orbiting telescope launched in April 1991, revealed that the distribution of the bursters seemed to suggest extragalactic origins. Hence scientists had focused on conceiving what kind of violent forces could produce high-energy gamma rays that could be detected by Earth-orbiting spacecraft. Several scientists proposed that the bursts involved catastrophic encounters of ultra dense neutron stars with each other or with black holes. Astrophysicists conceded that there might be no single source or explanation for the bursters; it was possible that the flashes were related to some physical process still unknown. (*NY Times*, Jan 26/93)

- House of Representatives freshmen, one-third of the 110 new House members, want to serve on the Science, Space, and Technology Committee. Twenty new members won seats on the committee. The main draw appeared to be the potential for scientific research and applied technology to save or create jobs in their districts. Committee members could promote technology programs without earmarking Federal funds for specific areas. (*W Post*, Jan 26/93)

- After a two-day trip, a Soyuz rocket docked with the Mir Space Station, using an apparatus designed to link the orbiter with a U.S. Shuttle. On board were two Russian cosmonauts. They were scheduled to replace the two cosmonauts who have been on Mir for the past six months. James Oberg, an expert on former Soviet science and technology, said that "the success of this test clears some worries about the hardware functioning properly." (*B Sun*, Jan 27/93; UPI, Jan 26/93)

January 27: NASA Administrator Daniel S. Goldin awarded test pilot A. Scott Crossfield the NASA Distinguished Service Medal for his contributions to aeronautics and aviation during his career of 50 years.

Crossfield played a key part in NASA's research aircraft program in the late 1950s and early 1960s. Recently he had been a key proponent of the National AeroSpace Plane (NASP) program, serving as technical consultant to the U.S. House of Representatives Committee on Science and Technology. (NASA Release 93-16; *Antelope Valley Press*, Feb 4/93)

- Three major aerospace companies announced cutbacks yesterday, with the states of Connecticut and Washington losing most of the jobs. Pratt & Whitney, a jet engine manufacturer whose plants are mainly in Connecticut, said that 6,700 jobs would be eliminated over the next 12 months. The Boeing Company announced that it would cut back production of all models of jet airliners. Such a downsizing could result in as many as 30,000 lost jobs. McDonnell Douglas, which had already announced that 8,700 jobs would soon be eliminated, most of them production jobs in its California factories, said that 1,500 white-collar jobs would disappear from its St. Louis headquarters. (*NY Times*, Jan 27/93; *WSJ*, Jan 27/93)

- Standard & Poor's Corporation downgraded its ratings on about \$1.7 billion of Lockheed Corporation's debt. The lowered ratings reflected Lockheed's proposed \$1.52 billion acquisition of General Dynamics Corporation's fighter plane unit.

In a separate announcement, Lockheed said that it had finalized a venture with Khrunichev Enterprises to market the Russian-built Proton rocket for commercial satellite launches. (*WSJ*, Jan 27/93)

- NASA Administrator Daniel S. Goldin and astronaut Mae Jemison visited the Challengers Boys and Girls Club in South-Central Los Angeles and announced funding of a science room in the club's new facility. The club runs all-day education, social, and sports programs, six days a week.

Writing in the *Los Angeles Times*, Louis Friedman, the executive director of The Planetary Society in Pasadena, California and past head of advanced studies at the Jet Propulsion Laboratory in California, urged the Southern California aerospace community to support efforts such as the Challengers Club. He wrote, "We have a special opportunity in Los Angeles because of the confluence of a large and changing aerospace industry with a larger and more changing social situation in our inner city." (*LA Times*, Jan 27/93)

- Robert S. Harrington, 50, an astronomer with the United States Naval Observatory in Washington, died of cancer January 23 at George Washington University Hospital. Dr. Harrington was known for his work concerning the possible existence of a 10th planet beyond the orbit of Pluto. He also focused on precise stellar distances, solar system dynamics, and multiple star dynamics.

Dr. Harrington received the Simon Newcomb Award from the Naval Observatory for his work on the dynamics of the solar system. Minor Planet 3216 was named after him. (*W Post*, Jan 27/93; *NY Times*, Jan 27/93)

January 28: NASA's newly formed Minority Business Resource Advisory Committee met in Washington to discuss their charter and to begin developing an agenda. NASA Administrator Daniel S. Goldin, who formed the group, charged them with helping NASA respond to a directive from Congress that required the Agency to award eight percent of the total value of the Agency's contracts to economically and socially disadvantaged businesses and minority educational institutions involved in key NASA activities. Goldin pledged in September that NASA would meet its eight percent goal. In an attempt to meet his pledge, the Agency identified 26 procurements that would be set aside for small disadvantaged businesses (SDBs) and for members of the Small Business Administration's 8(a) program for minority-owned firms. (NASA Release 93-17; *Federal Computer Week*, Feb 1/93; *Set-Aside Alert*, Mar 15/93)

- The Boeing Company and the four leading European aerospace companies, partners in the Airbus Industrie consortium, reached an agreement to conduct

a one-year study of the feasibility of jointly building a superjumbo airliner capable of carrying up to 800 passengers. (*NY Times*, Jan 28/93)

- *Washington Technology* reported that Rich Fleet, president of Herndon/Virginia-based PacAstro, planned to build an inexpensive launch rocket. Using technology from Apollo-era liquid rocket boosters and other reliable time-tested components, Fleet intended to offer 750-pound, low-Earth-orbit access for \$5 million a shot. This amount was half of what other mainline smallsat launch firms such as Orbital Sciences and EER were asking. Fleet also runs PacAstro's sister company AeroAstro, a manufacturer of low-cost smallsats. (*Washington Technology*, Jan 28/93)

- Working with a team of Hopkins scientists last spring, Kimberly Ennico, a 20-year-old junior at Johns Hopkins University, discovered a small flaw in the video camera that acts as a range finder for the Hopkins Ultraviolet Telescope scheduled for launch aboard a Space Shuttle in January 1995. Ms. Ennico discovered that the telescope's video range finder slightly distorted the positions of stars and distant galaxies. Her discovery allowed astronomers to compensate for the flaw by adjusting their computations. (*B Sun*, Jan 28/93)

- An analysis of more than 27,000 recordings of temperatures taken at various altitudes over the Arctic Ocean in the past 40 years did not show the global warming predicted by computer simulations, according to a report in the journal *Nature*. Coauthor Jonathan Kahl, an assistant professor of atmospheric science at the University of Wisconsin at Milwaukee, said that the findings do not disprove the warming theory. He added, "If they're not getting the Arctic quite right, then maybe they're not getting the whole picture quite right." (*W Times*, Jan 28/93; *USA Today*, January 28/93; *O Sen Star*, January 29/93)

- Flags flew at half-staff and flowers were placed at the astronauts' memorial at Kennedy Space Center on Thursday, the seventh anniversary of the Space Shuttle Challenger explosion. The Challenger explosion, which took place 73 seconds after liftoff on January 28, 1986, killed all seven on board. (AP, January 28/93)

January 29: The Senate confirmed John H. Gibbons as President Clinton's science and technology adviser. Gibbons was scheduled to direct the Office of Science and Technology Policy (OSTP), which advises the president on issues such as global warming, AIDS research, and support of science education in schools. A nuclear physicist, Gibbons, 64, headed the congressional Office of Technology Assessment (OTA) for 13 years. (*W Post*, Jan 29/93)

- Executives from two major players in the aircraft industry, United Technologies Corporation and General Electric Company, said that job cuts

and productivity improvement programs will not by themselves pull the industry out of its downturn. They were beginning to hint that they would like to team up with each other, perhaps through more joint research and development projects. Such hints might be merely a means of testing how far the Clinton administration would let them bend antitrust laws. However, even the suggestion of cooperation revealed the turmoil in the jet engine market, which was suffering because of slumping airline order and deep cuts in government spending on military aircraft. (*WSJ*, Jan 29/93)

- NASA announced that Kennedy Space Center (KSC) contract award protests were settled. EG&G Florida, Inc; BAMSI, Inc.; and Westinghouse KSC Company, Inc. protested the awarding of the contract to Lockheed Space Operations Company, charging that there were deficiencies in the Agency's activities during the original proposal submission. As part of the settlement, NASA agreed to rescind its original selection and said that each of the four competitors would be able to submit a revised proposal. (NASA Release 93-18; *WSJ*, Feb 2/93; AP, February 2/93; *O Sen Star*, Jan 19/93; *Fla Today*, Jan 29/93)

- In a report to Congress, the General Accounting Office (GAO) reported that NASA had underestimated the cost of its programs by billions of dollars. The report noted that original estimates for 25 of the 29 NASA programs GAO analyzed were too low. GAO found that more than a third cost more than double the early estimates, while only four cost less than those estimates. Most of the programs cost between 50 and 99 percent more than the early projections. One notable exception was Space Shuttle Endeavour; its \$1.8 billion cost was \$399 million less than the original estimate. NASA officials cited "overoptimism" as a reason why initial estimates were often significantly lower than current estimates. (*NY Times*, Jan 31/93; AP, Jan 30/93; *Space News*, Feb 8-14/94)

January 31: After conferring with Space Station contractor McDonnell Douglas, space officials confirmed that a cost overrun of at least \$500 million was expected if costs were not brought under control. They told a congressional panel that the Station was now a \$31.3 billion project. The increases appeared to be mainly in the Johnson Space Center portion of the program. NASA's Marty Kress, the Space Station project's new Deputy Director, said managers were determined to lower costs and were considering various means for doing so. Key congressional aides expressed anger at the news of the overrun, noting that for years NASA had ignored their advice on a design strategy to lower costs. (*W Post*, Jan 31/93; *Space News*, Feb 1-7/93; *O Sen Star*, Feb 3/93)

- In a 1992 report to Congress on the danger posed by asteroids smashing into Earth, NASA estimated that there were about 1,000 to 4,000 "near-Earth asteroids" larger than a half-mile, the minimum size capable of causing global disaster; such asteroids crash into Earth about once every 300,000 years.

According to the report, during our lifetime there was a small chance (very roughly 1 in 10,000) that the Earth would be struck by an object large enough to destroy food crops on a global scale and "possibly end civilization as we know it." (AP, Jan 31/93)

February

February 1: Daniel S. Goldin, NASA Administrator, presented Gene Roddenberry, creator of the *Star Trek* television series, NASA's Distinguished Public Service Medal on January 30. The medal, which was awarded posthumously, was presented to Roddenberry's widow, Majel Barrett Roddenberry. Gene Roddenberry died in October 1991.

Roddenberry was credited with popularizing the exploration of space through the original *Star Trek* television series, six motion pictures, and the later television series *Star Trek*. (NASA Release 93-019)

- Harris B. Hull, 83, a retired Air Force brigadier general and former Special Assistant to the Administrator of NASA, died January 29 at Sibley Memorial Hospital in Washington after a heart attack. General Hull was assigned to NASA in 1963. After retiring from the Air Force in 1964, he remained with NASA until retiring in 1986. (*W Post*, Feb, 1/93; *NY Times*, Feb 2/93)

- Two Russian cosmonauts returned to Earth on Monday after 189 days in space. The two cosmonauts made four space walks during their stay on the orbiting Space Station Mir and carried out a variety of experiments. (AP, Feb 1/93)

- NASA announced that it planned to launch a \$550 million-plus mission to repair the Hubble Space Telescope. Observers viewed the mission as very important for NASA's future; failure to repair the telescope would not only be a blow to astronomy but also would fuel the debate in Congress about NASA's ability to build Space Station Freedom later in the decade. The concern over the repair mission led to extensive oversight, numerous internal debates about the mission, and talk of a possible lengthening of the duration of the mission in order to allow for as many as six spacewalks. (*Space News*, Feb 1-7/93; *Science*, Feb 12/93; RTw, Mar 11; *B Sun Magazine*, Mar 14/93; *Time*, Mar 22/93)

- Jack Gibbons, President Bill Clinton's science advisor, said that the Clinton administration was debating various options for space policy management. Central was the question of whether to centralize control of the space program in a single White House office or spread out military, individual, and commercial space policy among several high-level councils. The role of science and technology in the Clinton administration was scheduled to be discussed during a January 30-31 meeting in Maryland. (*Space News*, Feb 1-7/93)

- NASA described Space Station Freedom as a laboratory for industry as well as government and set aside a third of the Station's experiment space for commercial research. NASA planned to begin launching pieces of Space Station Freedom into orbit in 1996. (*Space News*, Feb 1-7/93)

- NASA announced that Guy Gardner, NASA Deputy Associate Administrator for space flight—Russian programs, had been put in charge of overseeing two joint missions with the Russian space program.

In November, a cosmonaut was scheduled to spend eight days aboard the U.S. Space Shuttle Discovery. In 1995, an American and two cosmonauts were scheduled to take off aboard a Russian Soyuz rocket for a three-month stay aboard the Mir Space Station. The following June, the Shuttle Atlantis, carrying two cosmonauts, four Americans, and a Russian-built docking system, were scheduled to link up with Mir for five days of joint medical research. The American astronaut and the two cosmonauts launched in March would return to Earth on Atlantis. (*Space News*, Feb 1-7)

- NASA said that the titanium weld in Columbia's main engine might be weak; engineers were attempting to determine whether the weld was strong enough for the Shuttle's scheduled launch later in the month. NASA spokesman George Diller said that the turbopump would be replaced if the weld did not meet safety standards. (*AP*, Feb 1/93)

- NASA announced that five NASA officials would leave as the Clinton administration took office: Bill Livingstone, Associate Administrator of Public Affairs; Sue Richard, Livingstone's Deputy; Courtney Stadd, acting Associate Administrator for the Office of Advanced Concepts and Technology; Holly Stevens, an administrative assistant; and Robert Simon, writer and editor in Administrator Daniel Goldin's office. (*Space News*, Feb 1-7/93)

February 2: NASA announced that additional analysis had revealed that a suspect weld in Columbia's main engine fuel pump was strong enough for the Shuttle's scheduled launch late in the month. Liftoff tentatively was set for February 25. (*AP*, Feb 2/93)

February 3: NASA added a spacewalk to Space Shuttle mission STS-51 aboard Discovery, set for launch in July. The spacewalk would continue extravehicular activity tests that began with the addition of a spacewalk to NASA's first Shuttle flight in January of this year. (NASA Release 93-21)

- Joseph George Sobala, 60, a retired chief of the communications systems branch of NASA, died of cancer January 29 at his home in Washington, DC.

Mr. Sobala joined NASA in 1963 at the Goddard Space Flight Center in Greenbelt, Maryland. In 1977, he moved to NASA Headquarters as communications program manager; he was later promoted to the position of chief of the communications systems branch, a post he held at the time of his retirement on January 25. (*W Post*, Feb 3/93)

- Callers jammed switchboards at Cape Canaveral, Florida, reporting that a fiery object had lit up the night sky over the Southeast. People in Georgia,

Alabama, North Carolina, and Tennessee reported seeing an object streak across the sky about 10 p.m. Tuesday. Some observers said the object hit the ground and exploded. NASA confirmed that it had launched a navigation satellite at that time, but the boosters fell into the Atlantic Ocean as planned, said Gary Peltier, a spokesman at Cape Canaveral. (AP, Feb 3/93; B Sun, Feb 4/93)

- NASA appeared to be receiving little attention from the Clinton administration. Neither administration representatives nor NASA officials were present when a House subcommittee held the first of at least 10 hearings planned for this year to set space program priorities. Meanwhile, the White House had no comment on whether it would retain Daniel S. Goldin as NASA Administrator or choose a new head. (O Sen Star, Feb 3/93)

February 4: A commercial suborbital rocket carrying seven experiments was scheduled to be launched on February 10 by the University of Alabama in Huntsville's Consortium for Materials Development in Space (UAH CMDS), a NASA Center for the Commercial Development of Space. The Consort rocket and launch services are funded by a grant from the Space Agency's Office of Advanced Concepts and Technology. (NASA Release 93-22)

- Ellen Ochoa, the first Hispanic woman astronaut, was scheduled to be a mission specialist on the Shuttle Endeavour launch March 23. Her mission raised anticipation in the Hispanic community, and NASA invited several Hispanic educators and activists to be present at the launch. NASA planned to send Ochoa on a tour of several cities later in the year. (El Sol, Feb 4/93, Feb 10/93)

- Motorola Inc. announced yesterday that it had contracted with a Russian firm, Khrunichev Enterprises, to launch 21 of the satellites needed for Motorola's proposed \$3.37 billion Iridium communications network. The Iridium project, scheduled to begin operating in 1998, required various government approvals and a definitive financing agreement before it could go forward. (B Sun, Feb 4/93; WSJ, Feb 4/93; W Times, Feb 4/93; C Trib, Feb 4/93; UPI, Feb 21/93)

- A modified troop and cargo plane described as a "flying laboratory" crashed and burned after taking off from Dobbins Air Force Base in suburban Atlanta. The seven people aboard, all Lockheed employees, were killed. The plane, a modified troop and cargo plane, was used by Lockheed for testing new technologies. (B Sun, Feb 4/93)

- NASA officials said that Germany was being charged only \$150 million of the \$400 million cost of launching a science mission aboard Shuttle Columbia on February 25. Columbia's crew was expected to include two German researchers and a laboratory of German science experiments. The price was agreed upon in 1986 under a pricing policy NASA officials admitted was outdated. (O Sen Star, Feb 4/93)

February 5: Dr. Lonnie Reid, a fluid dynamics expert at NASA's Lewis Research Center in Cleveland, was scheduled to be inducted into the Ohio Science Technology and Industry Hall of Fame in Columbus on February 7.

Reid, who would be the first NASA researcher and one of three African Americans in the Hall of Fame, was being honored for his pioneering work in integrating theoretical and experimental methods in the science of fluid dynamics. (NASA Release 93-23)

- NASA Administrator Daniel S. Goldin announced that the agency had exceeded its 1992 goal of awarding 6.7 percent of the total value of the Agency's prime and subcontracts to small disadvantaged businesses. Over \$865 million was awarded to minority organizations; this figure represented 7.2 of the total \$12 billion awarded during the last fiscal year. (*National Black Review*, Feb 5/93)

- Senior Astronaut Jerry Ross, payload commander for the Shuttle Columbia's February 25 mission, said that NASA should revamp globe-spanning training because such programs endangered fliers' family life and could lead to physical and mental exhaustion. Ross and another astronaut spent about 28 weeks in Germany preparing for the German spacelab mission aboard Columbia. (*USA Today*, Feb 5/93; *W Times*, Feb 5/93; *AP*, Feb 4/93; *Space News*, Feb 8-14)

- Russians scientists and engineers unfurled a thin aluminum and plastic mirror in space, sending a narrow beam of reflected sunlight flashing across the night side of the Earth. The experiment could be the first step in creating a solar spotlight that could eventually be used to light up nighttime work, rescue operations, blacked-out cities, or Sun-deprived polar areas. The main purpose of the test was to see whether the sheet could be opened using centrifugal force and then maneuvered. (*W Post*, Feb 5/93; *P Inq*, Feb 5/94; *NY Times*, Feb 5/93)

- The Clinton administration considered cancelling NASA's \$30 billion Space Station and the \$8.2 billion Super Collider but decided to keep the programs after encountering intense opposition to their cancellation. Cost overruns on the two programs, however, have damaged their political prospects in the administration and Congress. (*Space News*, Feb 8-14/93; *AP*, Feb 6/93, 8/93; *UPI*, Feb 5/93, Feb 8/93; *W Post*, Feb 6/93; *W Times*, Feb 6/93; *P Inq*, Feb 6/93; *B Sun*, Feb 6/93; *NY Times*, Feb 6/93)

February 7: The Federal Aviation Administration was studying a controversial proposal to improve pilot alertness and performance by scheduling naps in the cockpit on long-haul flights. The proposed nap policy would apply only to three-pilot crews; two pilots would be on duty at all times while the third one slept. At least one union representing pilots strongly objected, charging that

the proposal would sacrifice public safety, while allowing the airlines to save money by reducing the number of pilots.

A NASA study of log books kept by pilots and published in December 1991 reported that pilots took naps in the cockpit 11 percent of the time they were on duty. (*Boston Sunday Globe*, Feb 7/93)

February 8: Richard B. Hoover of the Marshall Space Flight Center, Huntsville, Alabama, was named NASA inventor of the year for his invention of the Water-Window Imaging X-ray Microscope. This instrument should enable researchers to see in great detail high contrast x-ray images of proteins, chromosomes, and other tiny carbon structures inside living cells. (NASA Release 93-024)

- NASA officials announced that they planned to eliminate a number of expensive facilities and delay several Space Station assembly missions in their attempt to cut growing cost projections for the program. Senior program officials said that they had reduced \$1.08 billion in anticipated cost increases for the Space Station to \$678 million. (*Space News*, Feb 8-14/93)

- Orbital Sciences Corporation of Fairfax, Virginia, announced that it was again planning to launch its Pegasus orbital rocket after scrubbing launches three times in the past two months because of technical problems.

Pegasus, a winged, three-stage rocket that can put payloads weighing as much as 900 pounds into low-Earth orbit, was to launch a data-relay satellite that was designed and built in Brazil. The rocket would be dropped from the wing of a B-52 bomber airborne 80 miles off Florida's east coast. The satellite, which weighs 350 pounds, was designed to help monitor Brazil's environment. (*W Post*, Feb 8/93; *USA Today*, Feb 8/93); *USA Today*, Feb 9/93)

- NASA Administrator Daniel S. Goldin instructed senior NASA managers to begin a five-month study that would examine whether to replace the Space Shuttle after 2005 or upgrade the fleet so that shuttles could fly until 2030. The study was being led by Arnold Aldrich, NASA Associate Administrator for Space Systems Development. (*Space News*, Feb. 8-14/93)

- NASA added a spacewalk to a U.S. Shuttle mission scheduled for July as part of a continuing program to give astronauts experience before the start of Space Station construction in 1996. (*Space News*, Feb 8-14/93)

- Some NASA scientists, following the "faster, better, cheaper" advice of NASA Administrator Daniel S. Goldin, want to send two small space probes to study Pluto, the solar system's last known unexplored planet. The Plato mission could cost \$600 million to \$1 billion, depending on whether the probes were reached by Russian or U.S. rockets, respectively. By comparison, NASA expected to spend more than \$2 billion to launch a spaceship in 1997 to explore Saturn. (AP, Feb 8/93)

- A first formal industrial test of a system that uses computer-set lights to adjust a person's sleep patterns got underway in January at a San Diego Gas and Electric Company plant. The system may prove useful in keeping astronauts and night workers alert, easing jet lag, helping older people sleep, and helping teens get out of bed. NASA started using the system in 1991 to adapt astronauts to night launches and shift work.

In the test, doses of light were applied late in the evening to delay the onset of sleepiness or at other times to fool the body's internal clock. The illumination was 50 to 100 times brighter than normal indoor light, but only about one-thousandth as bright as sunlight on a sunny day. (AP, Feb 8/93)

- Officials at NASA's Jet Propulsion Laboratory (JPL) recommended eliminating the JPL Edwards Test Facility, staffed by 28 JPL employees and 18 contractors, at Edwards Air Force Base in the Mojave Desert. If NASA managers accepted the recommendation, the facility could shut down by 1996. (UPI, Feb 8/93; Feb 9/Antelope Valley Press, Feb 9/93)

February 9: Robert M. Rados, 73, a retired NASA meteorologist, died of cardiac arrest February 3 at Georgetown University Hospital, Washington, D.C.

Mr. Rados joined NASA in 1961. His work there included service as project manager for the TIROS weather satellite program and global atmospheric research. He retired in 1980. (W Post, Feb 8/93)

- Space scientists at NASA's Ames Research Center, Moffett Field, California, think they have identified what matter in deep space is absorbing certain wavelengths of light from distant stars. Researchers Farid Salama and Louis Allamandola demonstrated that the light is absorbed by unexpectedly large organic molecules spread throughout the vacuum of space. These molecules, shaped like chicken wire, are called polycyclic aromatic hydrocarbons (PAHs).

Salama said, "We think PAHs are the by-product of old carbon-rich stars burning out. This challenges the traditional view of interstellar chemistry, which assumes that all interstellar molecules are produced in the interstellar medium." (NASA Release 93-025)

- Daniel S. Goldin, NASA Administrator, who described himself as "an agent of change" in a late-November interview with *Government Executive* magazine, has set about instituting the "faster, better, cheaper" goals popularized over the past two years by the National Space Council.

Employee review teams set in motion by Goldin came up with 17 percent reduction in future program costs. Most of these savings would come from repackaging NASA satellites into smaller, less expensive parcels. Goldin also committed himself to diversifying NASA's top management. He noted that he had moved "four brilliant, distinguished black Americans" into senior slots and also had promoted women and pushed contracts for minority firms.

Goldin also addressed customer and supplier relations. Reaching out to what he calls NASA's "customer"—the American people—Goldin held a series of six "town meetings" around the country late last year to talk about NASA and answer questions. Goldin also was looking to change the Agency's relationship with its suppliers. A recent General Accounting Office report found that costs in a sampling of 29 NASA projects were running 75 higher, on average, than had initially been projected. Goldin declared war on the practice of companies under-bidding and hoping to make up the loss in later contracts. (*Government Executive*, Feb/93)

- A Pegasus rocket launched from a B-52 bomber flying eight miles above the Atlantic Ocean propelled a Brazilian environmental satellite into orbit. The Pegasus was dropped off the wing of the B-52, which was modified by NASA. After five seconds of free fall, the rocket motors were fired one by one and lifted the satellite into an orbit about 470 miles high.

The satellite, which cost \$20 million, was designed to monitor the Amazon River and surrounding rain forests. It was built by Brazil's space agency and launched by the Orbital Sciences Corporation of Fairfax, Virginia. The satellite was the first of a series of satellites planned by Brazil. (*AP*, Feb 9/93; *UPI*, Feb 9/93; *USA Today*, Feb 10/93; *W Times*, Feb 10/93; *Phil Inq*, Feb 10/93; *NY Times*, Feb 10/93; *WSJ*, Feb 10/93; *W Post*, Feb 10/93)

February 10: The National Air and Space Museum's new permanent exhibition, "Where Next, Columbus?" sums up U.S. space explorations to date and attempts to guess what lies ahead. The show ends without any firm answers; exploration is limited by technological feasibility, but it is also, as this exhibition emphasizes, very much a cultural enterprise, shaped by the values of a given society. (*P Inq*, Feb 10/93)

- The Smithsonian Museum put the Air and Space Museum Annex proposed for Dulles Airport on its priority list for 1993. The annex would display, for the first time, such pieces of aeronautical history as the Enola Gay atomic bomber, the Space Shuttle Enterprise, and the SR-71 "Blackbird" spy plane.

Representative Frank R. Wolf of Virginia reported that very likely both houses of Congress would soon be getting legislation authorizing construction of the Annex at Dulles Airport. Construction of the Annex had been delayed for years because of disagreement in Congress as to its location. (*Reston Connection*, Feb 10/93)

- President Clinton dissolved the Cabinet-level National Space Council as part of staff cuts to reduce the budget. The duties of the Space Council were to come under the umbrella of a broader policy-making group called the Office of Science and Technology Policy headed by new presidential science adviser Jack Gibbons. (*H Chronicle*, Feb 10/93; *Space News*, Feb 15/93)

February 11: NASA announced that scientist Dr. Robert Watson would receive the Scientific Freedom and Responsibility Award from the American Association for the Advancement of Science (AAAS) on February 15.

The AAAS was to honor Dr. Watson, Director of the Process Studies Program Office in NASA's Earth Science and Applications Division, and Dan Albritton of the National Oceanic and Atmospheric Administration (NOAA), for their contributions to the scientific and policy discussions on global ozone depletion. (NASA Release 93-26)

- NASA announced the selection of 11 new science mission concepts in the Discovery Program for further study during this fiscal year. The Discovery missions were selected from 73 concepts discussed at the Discovery Mission Workshop held last November. The potential projects were those thought to have the highest scientific value as well as a reasonable chance of meeting budgetary guidelines. Discovery missions were designed to proceed from development to flight in less than three years.

The 11 mission concepts to be studied were: Mercury Polar Flyby, Hermes Global Orbiter to Mercury, Venus Multiprobe Mission, Venus Composition Probe, Cometary Coma Chemical Composition, Mars Upper Atmosphere Dynamics, Energetics, and Evolution Mission, Comet Nucleus Tour, Small Missions to Asteroids and Comets, Near Earth Asteroid Returned Sample, Earth Orbital Ultraviolet Jovian Observer, and Wind Sample Return. In addition, three concepts were targeted for further consideration during the fiscal year: Mainbelt Asteroid Rendezvous Explorer, Comet Nucleus Penetrator, and Mars Polar Pathfinder. (NASA Release 93-027)

- Astro-D, a cooperative x-ray astronomy mission with Japan's Institute of Space and Astronautical Science (ISAS) and NASA, was scheduled for launching February 11 from the ISAS Kagoshima Space Center in Japan.

The Astro-D project, which was to put a high-capability x-ray observatory into orbit, had been designed to help understand the physics of a variety of cosmic sources. During early operations, the observatory's four telescopes were to point at approximately two targets per day. This number would be increased to as many as six per day; the targets would include supernova remnants, stars, neutron stars, black holes, active galactic nuclei, and clusters of galaxies. (NASA Release 93-28)

- NASA completed its review of the flight readiness of Columbia Shuttle Mission STS-55, a mission dedicated primarily to the German Space Agency for research in life and microgravity sciences. During the review, inspectors decided to replace the Shuttle's high pressure oxidizer pumps.

The replacement comes because officials were uncertain whether the retainers for seals in Columbia's high-pressure oxidizer pumps were a new and tighter kind or an old variety. If a retainer broke, a piece of it could damage the turbine blades and the engine could shut down, according to Larry Salter,

a main-engine expert at NASA. A paperwork problem caused the confusion. NASA officials said that at least some of the eight Space Shuttle missions launched since March 1992 might have been put into orbit without proper inspection of the retainers. (NASA Note to Editors: N93-7; *B Sun*, Feb 11/93; *USA Today*, Feb 11/97; *W Post*, Feb 11/93; *P Inq*, Feb 11/93; AP, Feb 11/93; *NY Times*, Feb 12/93; *Av Wk*, Feb 15/93)

- The Russians have attempted to sell previously classified Soviet satellite pictures to American scientists and oil companies. The photographs were not taken by Soviet spy satellites but by other spacecraft, such as the Mir Space Station. Oil companies considering prospecting for oil in Russia were particularly interested, according to Sergey Vikhrov, of the All-Russian Foreign Economic Association on Geological Prospecting. (AP, February 11/93)

February 12: According to reports, the Clinton administration's new budget would cut funding for NASA's planned Space Station by 40 percent; the cuts were predicted to trigger another major restructuring of the project and more delays. Key Capitol aids said the House had approved \$1.35 billion for the program in the next fiscal year, instead of the \$2.25 billion NASA had requested, Clinton was reported to be troubled by the massive cost-overruns associated with the project. (*W Post*, Feb 12/97; AP, Feb 12/93, Feb 13/93; UPI, Feb 12/93, Feb 13/93)

- In 1989, NASA embarked on a vast program, the Mission to Planet Earth, which set out to monitor the effects of climate change on Earth's atmosphere, land surface, and oceans. The centerpiece of this program was to be the Earth Observing System, or EOS, a group of 30,000-pound space platforms that could cost as much as \$30 billion to build, launch, and operate. The platforms were projected to beam home one trillion bits of data each day, ranging from the flux of solar radiation into the atmosphere to the growth of plankton beneath the ocean surface.

Controversy had surrounded the EOS program since its inception; critics argued that EOS was a grandiose program that would produce huge amounts of undigestible data and would take money away from other—perhaps more useful—efforts at climate monitoring. Critics continued to maintain that long-term, continuous monitoring of crucial climate variables, monitoring that has been postponed until EOS gets launched, would be more useful.

The EOS budget through the end of the century had been trimmed from \$17 billion to \$8 billion and the mission had been modified. If the budget got much tighter, NASA would have to completely rethink Mission to Planet Earth. (*Science*, Feb 12/93)

- WorldView Imaging of Livermore, California received a government license to launch small, inexpensive spy satellites. WorldView claimed that it could take super-sharp photos from 250 feet up and sell the photos for about

half the \$4,000 charged by the government's Landsat and France's SPOT Image. Possible uses included traffic monitoring, urban planning, and corporate spying. (*USA Today*, Feb 12/93; *NY Times*, Feb 12/93)

- A panel of experts tasked with examining the Space Shuttle's main engines said that they were safe to fly provided that technical checks were made "vigorously and rigorously." The panel noted that the engines were so fussy that they needed constant maintenance. Such attention was one of the factors that had driven the cost of each Shuttle flight to about \$500 million. The panel suggested that NASA continue to press forward on a number of technical improvements already in the works. (*AP*, Feb 12/93)

- According to officials at NASA, a bad lot of batteries, made by Gates Aerospace Battery Company, might shut down several satellites, including the \$363 million Upper Atmosphere Research Satellite (UARS) sooner than expected. To make sure that UARS would finish its minimum 18-month mission, NASA scientists had to adjust the satellite's hardware. Instead of gathering extra data from UARS for 10 to 12 years as expected, scientists now estimate that contact with the satellite would last only four or five years. (*Science*, Feb 12/93)

February 13: NASA released 45 photos of the Space Shuttle Challenger's smashed crew cabin, after they were given to the *New York Times* by a man who had obtained them under the Federal Freedom of Information Act. The pictures were taken after the crew cabin was recovered from the Atlantic Ocean in 1986. (*AP*, Feb 15/93; *B Sun*, Feb 15; *W Post*, Feb 15/93; *USA Today*, Feb 15/93; *P Inq*, Feb 15/93; *NY Times*, Feb 13/93)

- NASA's Dryden Flight Research Facility at Edwards Air Force Base in California announced that nearly two dozen engineers from the Center would visit 22 schools in the Antelope Valley to celebrate National Engineer's Week. (*LA Times*, Feb 13/93)

- In response to questions from reporters, President Clinton said that there might be some changes in the space program but that supporters of NASA should be pleased with his recommendations. He gave no details, but White House officials said the President would call for full funding for the Space Station when he addressed Congress February 17. John H. Gibbons, the President's science advisor, on the other hand, said that big science projects would be cut back as the administration searched for ways to pay for them. (*AP*, Feb 13/93, Feb 16/93; *Space News*, Feb 15-21; *LA Times*, Feb 13/93; *USA Today*, Feb 17/93)

- John Aaron, the project manager of the Space Station, resigned after Senator Bob Krueger, D-Texas, demanded Aaron's resignation in return for continued funding for the project. Krueger said Aaron must be removed because "precious tax dollars have been mismanaged. There is no question

that a new management team must get to work immediately to increase efficiency and productivity." (UPI, Feb 13/93)

February 15: A *New York Times* editorial suggested that if pain was to be spread fairly, the country's two biggest science projects, the \$8.3 billion Superconducting Super Collider now being built in Texas and the \$30 billion Space Station, had to be cut along with other vital programs.

The editorial noted that some reviews have said that the Space Station had only one important goal that cannot be met on Earth: it would serve as a base for biomedical studies of what happens to humans and animals who remain in space for long periods. That goal, the editorial suggested, could be met more cheaply. A harder call, according to the editorial, was the Super Collider because, according to all accounts, this was a pioneering research project designed to yield secrets of matter that could not be found any other way. But in the end, big science must do its share. (*NY Times*, Feb 15/93)

- NASA managers and engineers warned that infighting and confusion jeopardized the Space Station effort. Critics said that NASA must strengthen accountability, do away with bureaucratic constraints, and forge a more cohesive team. There was widespread disagreement among Space Station players over whether NASA should make some personnel changes or take a more radical path, for example, invest more authority in the program office in Reston, Virginia, or concentrate effort at a single NASA center. (*Space News*, Feb 15-21/93)

- Russian scientists from the Baikonur Center near Moscow and their U.S. colleagues from the NASA Ames Research Center, Stanford University, and McDonnell Douglas Corporation have been working to build more enthusiasm for exploration of Mars. Joint efforts were needed if exploration were to go forward said Dr. Louis D. Friedman, executive director of The Planetary Society, a Pasadena-based international space advocacy group. The society was a partner in the Russian mission to launch orbiters scheduled to carry robotic explorers to Mars in 1994 and 1996. (AP, Feb 15/93; *W Times*, Mar 14/93)

- Seven of the Federal government's inspectors general last year accepted bonuses—up to \$20,000—from the agencies they review. NASA's inspector general, Bill Colvin, received the biggest bonus, \$20,000. Colvin said the cash would not sway him. "If I've got an allegation against the head of my agency, he said, "the chips are going to fall where they may." (*USA Today*, Feb 15)

February 16: NASA, the Jet Propulsion Laboratory (JPL), and the Southern California Small Business Utilization Council were scheduled to co-sponsor the 1993 High Technology and Small Business Development Procurement Conference on March 1-2 in Los Angeles. About 200 government prime contractors, Federal agencies, and other large procurement organizations were expected to participate in the conference. (NASA Release 93-029)

- NASA announced that a mysterious glitch had caused the Ulysses solar explorer spacecraft to shut down its instruments and stop sending data over the weekend. Eight of the instruments were working by the Tuesday following the shutdown, and NASA predicted that the ninth instrument would be operational within days. A similar, still unexplained malfunction occurred in 1991. Ulysses was released from a Space Shuttle in 1990 on a \$750 million mission to study the Sun's poles in 1994-95. (AP, Feb 16/93; *W Post*, Feb 17/93); *USA Today*, Feb 17/93; AP, Feb 17/93)

February 17: NASA announced that a study at NASA's Ames Research Center, Moffett Field, California, might lead to a reduction in the lightheadedness astronauts feel after returning to Earth from space. A reduced level of plasma was believed to contribute to the tendency to feel faint. (NASA Release 93-030)

- A spacewalk was added to Space Shuttle mission STS-57 aboard Space Shuttle Endeavour as part of a series of spacewalk tests NASA planned to conduct during the next three years to prepare for the construction and maintenance of Space Station Freedom. Endeavour was scheduled for an April launch. The main objectives of the STS-57 mission were retrieval of the European Retrievable Carrier (EURECA) deployed during a Shuttle flight in August 1992 and the conducting of research in the Spacehab module. (NASA Release 93-31)

- Bernard A. Harris, MD, an African American, was set to make his first Shuttle flight aboard Space Shuttle Columbia in late February. He was scheduled to conduct experiments exploring the behavior of humans, living organisms, and materials.

The February launch would be Columbia's 14th voyage into Earth orbit. The primary payload was Spacelab D2, a self-contained, space-based research laboratory carried inside the Shuttle's 60-foot-long cargo bay. (*Philadelphia New Observer*, Feb 17/93)

- The Clinton administration decided to increase funding and continue work on the \$8.2 billion Superconducting Super Collider under construction in Texas, according to Senator Bob Krueger, D-Texas, and other sources. Krueger said that Clinton's Office of Management and Budget had budgeted the project at \$640 million for fiscal 1994, a 24 percent increase over the current year's spending levels. However, just before he left office last month, outgoing Energy Secretary James D. Watkins said that the 1994 funding level would have to be \$1.2 billion to keep the project on schedule for completion by the end of the decade. (*W Post*, Feb 17/93)

- Speaking on CNN's morning news show, Senator Jim Sasser, D-Tennessee, chairman of the Senate Budget Committee, called the Superconducting Super

Collider a \$7 billion scientific pork barrel. He said he would propose cutting it out of the budget along with the Space Station. (AP, Feb 7/93)

February 18: The President's 1994 budget request for NASA called for an increase over last year's budget and contained key provisions for the Space Station program and the development of important new technologies. The President was to propose a \$14.7 billion budget for NASA for fiscal year 1994, up from \$14.1 billion during the current year.

President Clinton directed NASA Administrator Daniel S. Goldin to redesign the Space Station. Goldin said that NASA officials would come up with new designs, expected within 90 days, that increased the project's efficiency and produced "greater returns on our investment." (NASA Release 93-32; *W Post*, Feb 18/93, Feb 19/93; *WSJ*, Feb 17/93, Feb 18/93, Feb 19/93; *NY Times*, Feb 18/93, Feb 19/93; *B Sun*, Feb 18/93; *P Inq*, Feb 18/93; AP, Feb 18/93; UPI, Feb 18/93, Feb 19/93, Feb 20/93, Mar 3/93; AP, Feb 17/93; *W Post*, Feb 19/93; *NY Times*, Feb 19/93; *WSJ*, Feb 19/93; AP, Feb 19/93; AP, Feb 19/93; UPI, Feb 19/93; *LA Times*, Feb 22/93; *Space News*, Feb 22-23; *AvWk*, Feb 22/93)

- Speaking at a press conference at the annual meeting of the American Association for the Advancement of Science, John Gibbons, President Clinton's science advisor, said that science and technology would take center stage as the dual engine for economic growth in the United States. He added that the administration would need to make some hard choices about expensive projects such as the Space Station, find ways to gain more practical benefit from basic scientific research without limiting its creativity, and learn to be a true international partner. (*CSM*, Feb 18/93; *W Post*, Mar 3/93)

- According to NASA, President Clinton's plans for the Space Station could threaten some of the 125 Maryland jobs connected with the project. About \$14 million was being spent in Maryland on station-related work. (*B Sun*, Feb 18/93)

February 19: NASA announced the selection of 111 research proposals for immediate negotiation of Phase II contracts in NASA's Small Business Innovation Research Program (SBIR). These proposals and the 38 previously selected proposals came from 130 small, high technology firms located in 27 states. The SBIR program is intended to stimulate technological innovation by using small businesses, including minority and disadvantaged firms, to help meet Federal research and development requirements and to encourage the commercial application of federally-funded research innovations. (NASA Release 93-33; *Washington Technology*, Feb 25/93)

- Russia's Mir Space Station celebrated its seventh anniversary in orbit on February 20. The Mir has given Russian cosmonauts much experience with extended periods in space. About a half dozen cosmonauts have made multiple flights and spent a total of more than a year in orbit. (AP, Feb 19/93)

- NASA announced that three engine pumps—removed from Space Shuttle Columbia for fear that the seal retainers in the pumps were an old variety that required inspection after each flight—were a newer version that did not need automatic pre-flight inspection. The confusion stemmed from a paperwork mixup at the Rockwell International Corporation, maker of the engines. (*NY Times*, Feb 19/93)
- The White House released estimates of the number of job cuts faced by each Federal agency. NASA was slated to lose 1,000 positions. (*W Post*, Feb 19/93)
- George A. Burch, 62, an engineer who since 1960 had worked on various NASA projects, died of lung cancer January 25 at Greater Laurel-Beltsville Hospital in Maryland. Mr. Burch was employed by Bendix Corporation. (*W Post*, Feb 19/93)
- Writing in the *Washington Post*, Michael Schrage, a columnist for the *Los Angeles Times*, suggested that a dramatic and effective way to boost the Nation's industrial competitiveness while sending a signal that the Cold War was over would be to cut in half the budget of the national laboratories. The move might shock the labs into more energetically redefining their mission, according to Schrage. The national labs include the University of California's Lawrence Livermore Lab, Los Alamos in New Mexico, and Brookhaven in New York. (*W Post*, Feb 19/93)

February 21: Arthur L. H. Rudolph, a German-born scientist who played a crucial role in developing the Saturn 5 rocket used in the American Moon landings, lost his attempt to regain his American citizenship. He gave up his citizenship in 1984 when he faced deportation for Nazi war crimes.

After the war, Rudolph was one of 118 German scientists secretly brought to the United States to work in the American missile program. He became the Space Agency's program manager for the Saturn project. (*NY Times*, Feb 20/93)

February 22: NASA announced that NASA and industry engineers had designed and built a new measuring device that would save American taxpayers more than \$1 million on a NASA project. The device, an improved "inlet rake," measures the air flowing into one of the engines on the F/AS-18 High Alpha Research Vehicle (HARV), based at NASA's Dryden Flight Research Facility, Edwards, California. Engineers would be able to use the air flow data to help give fighter-type aircraft more power and better handling qualities. (NASA Release 93-035; *Antelope Valley Press*, Mar 19/93)

- NASA managers and industry contractors blamed Space Station cost overruns on the rush to redesign the effort in 1990 and 1991. Congress directed NASA in October 1990 to shave \$6 billion from the Space Station over five years. NASA settled on a plan in early 1991 to shorten the pressurized mod-

ules and reduce the number of solar arrays. The Agency also pushed back the date when the crew could occupy the Space Station by two years—to 1999—and reduced the crew size by half. In addition, NASA redid plans for the lattice-work structure that forms the Space Station's backbone and the Johnson Space Center's major responsibility in the program. According to Jack Boykin, Johnson's acting Project Director, the plan was too optimistic in its estimates of cost and technical complexity.

Robert Moorehead, NASA's Deputy Program Director for the Space Station, warned his superior in writing on March 13, 1992, that the Center's work was veering out of control. His concerns suggested that the Space Station's problems were recognized within the Agency well before they became public. (*Space News*, Feb 22-28)

- An editorial in *Aviation Week and Space Technology*, praised President Bill Clinton as generally being "on track" with his space and aeronautics program. However, the author suggested that President Clinton needed to clarify his vision for the Space Station; decisive action was needed in a project that already had consumed \$8 billion over nearly a decade. An editorial in the *Orlando Sentinel* urged President Clinton to keep his commitment to the Space Station but to do so with an "eye toward greater efficiency." (*AvWk*, Feb 22, 1993; *O Sen Star*, Feb 22/93)

- *Space News* praised President Bill Clinton's space plan as a "rational, sound approach that will keep the station alive, head NASA in the right direction, and keep NASA Administrator Dan Goldin around." (*Space News*, Feb 22-28/93)

- Writing in the *Wall Street Journal*, Allan H. Meltzer, professor of economics at Carnegie-Mellon and visiting scholar at the American Enterprise Institute, said that if the Clinton administration were serious about reducing spending it would eliminate the \$30 billion Space Station, reduce entitlements, and cut wasteful projects. (*WSJ*, Feb 22/93)

February 23: Kennedy Space Center spokesman Hugh Harris announced that former astronaut Brewster Shaw had told NASA that he would resign as Deputy Director of the Space Shuttle program in April. Shaw was responsible for approving Shuttle launches in the final moments of a countdown (*W Times*, Feb 23/93; AP, Feb 24/93)

February 24: A *Washington Post* editorial had generally favorable comments regarding President Clinton's economic stimulus-deficit plan, noting that he had taken on some formidable interest groups. It suggested, however, that he could have killed the Space Station as "unaffordable in present circumstances." A *Washington Times* editorial argued that both the Space Station and the Superconducting Super Collider should be cut. A *Philadelphia Inquirer* edi-

torial called for a delay in building the Space Station because of funding issues. (*W Post*, Feb 24/93; *W Times*, Feb 26/93; *P Inq*, Mar 7/93)

- NASA announced that new information on the El Niño ocean current would be discussed at a briefing on the TOPEX/Poseidon satellite mission on February 26. The satellite was launched in August 1992 to map circulation of the world's oceans and study the oceans' role in climate. (NASA Release N93-08)

February 25: NASA scientists reported in the British journal *Nature* that a supernova may have caused a huge void known as the "Local Bubble" that envelopes the solar system and many nearby stars. Researchers at NASA's Goddard Space Flight Center, Greenbelt, Maryland, said that evidence suggests that the bubble, an area about 300 light-years across, was formed by the supernova or explosion of a star about 340,000 years ago. The blast was strong enough that its radiation could have disrupted Earth's protective ozone layer and caused extra sunburns on the ancestors of modern humans. (NASA Release 93-036; *USA Today*, Feb 25/93; *NY Times*, Feb 25; *P Inq*, Mar 5/93)

- NASA announced that, beginning in February, it would test "technology incubation," a new laboratory-to-market approach designed to help space technology contribute to U.S. industrial competitiveness. NASA was funding two centers, the Ames Research Center, Moffett Field, California, and the Johnson Space Center, Houston. The three-year experiment, which was being operated by the University of Texas, Austin, was receiving funding of \$800,000 this year. (NASA Release 93-037)

- The General Accounting Office (GAO) reported that the Superconducting Super Collider was millions of dollars over budget and that construction was behind schedule. According to the investigators, trend analysis suggested that the Collider could have a \$650 million cost overrun; GAO also estimated that the project was 19 percent behind schedule. (*W Post*, Feb 25/93)

- Government officials reported that a high-altitude weather satellite borrowed from Europe had been positioned to monitor the weather over the United States. It joined the GOES-7 U.S. weather satellite, which had been working alone since its companion satellite failed in 1989. The addition of the European satellite restored the normal system of having two weather satellites in orbit, one each over the East and West Coasts. (*NY Times*, Feb 25/93)

- Daniel S. Goldin, NASA Administrator, named Dr. Joseph F. Shea, adjunct professor of aeronautics and astronautics at the Massachusetts Institute of Technology and former NASA employee, to be in charge of the redesign of the Space Station. Goldin also announced measures to conserve resources and restrict new spending during the redesign transition. (NASA Release 93-038; *Space News*, Mar 1-7; UPI, Feb 27/93; *W Post*, Feb 27/93)

- NASA announced funding for 11 mission concept studies that would attempt to design a solar system exploration mission for under \$150 million each. A parachute-descending Venus atmospheric probe proposed by the University of Colorado was one of the ideas funded. (*Washington Technology*, Feb 25/93)

February 26: NASA reported that data from the U.S.-French TOPEX/Poseidon oceanographic indicated that the El Niño event off the western coast of South America was strengthening, which meant that the weather conditions associated with it were likely to continue. These conditions included wetter than normal weather in California, wetter and colder winters than normal in the eastern United States, and warmer and dryer summers than normal across the southern hemisphere. (NASA Release 93-39; *B Sun*, Feb 28/93)

- NASA announced that Russian cosmonauts Colonel Vladimir G. Titov and Sergei K. Krikalev were scheduled to meet with the media for interviews on Tuesday, March 9. The two cosmonauts were training as mission specialists for Shuttle mission STS-60 set to be launched in late 1993. (NASA Editors Note N93-9)

- Benson Edward Gammon, 76, a retired research scientist with NASA, died on February 24. Mr. Gammon worked with NASA and its predecessor agencies for 32 years. He served as chief of research and technology in the office of plans and program evaluation, where he worked on the proposal for a manned flight to Mars. (*W Post*, Feb 26/93)

February 27: NASA announced that it had notified all its contractors to discontinue all overtime on Space Station work and said that it would “restrict new spending.” (*W Times*, Feb 27/93)

- Jet Propulsion Laboratory Director Edward Stone announced that the laboratory expected to eliminate 1,000 of its 7,500 jobs in five years. The cuts resulted from the “realities of the Federal budget” and the drop in aerospace work from defense contractors, according to Stone. (*W Times*, Feb 27/93)

- NASA announced that a German-chartered Space Shuttle mission was scheduled for launch March 14 after a delay of more than two weeks. NASA said the delay was caused by a false alarm with the space shuttle Columbia’s main engines, which were suspected of containing outdated parts. (*W Times*, Feb 27/93)

- The *New York Times* reported that an Orion rocket being prepared for launch at the European Space Range in Kiruna, Sweden, ignited while on its flatbed

and shot through two buildings, killing a technician and injuring three others. The 20-foot rocket was to have measured the Earth's ozone layer, using equipment from a German Space organization. (*NY Times*, Mar 1/93; RT, Feb 27/93)

March

March 1: *Texas Monthly* reported that Forrest M. Mims III, an amateur scientist who daily measures ozone readings with a pair of hand-held instruments put together for less than \$500, had convinced NASA that its multimillion-dollar spectrometer was off by about 1.7 percent. NASA's 14-year-old spectrometer, the Nimbus-7, apparently had drifted slightly in its orbit. It was scheduled to be replaced in 1994; until it was replaced, NASA scientists would have to compensate for the error. (*Texas Monthly*, Mar 1/93)

- *Government Computer News* reported that NASA had designated Laurie A. Broedling, an Associate Administrator for Continual Improvement, to take charge of the Agency's Total Quality Management (TQM) program. In addition, NASA established a quality steering team of senior officials and a continual improvement council. (*Government Computer News*, Mar 1/93)

- The Clinton administration announced that it was moving the management team for a Space Shuttle contract from the Marshall Space Flight Center in Huntsville, Alabama, to the Johnson Space Center in Houston, Texas. The decision affected 90 engineering and management employees. According to the *Wall Street Journal*, the move was meant to discipline Alabama Senator Richard Shelby, who, after lobbying the administration to continue funding the Space Station, had publicly criticized the President's economic program for failing to cut more from Federal spending. (*WSJ*, Mar 1/93; *Newsweek*, Mar 8/93)

- Writing in the *Christian Science Monitor*, James Oberg, a professional space engineer and a specialist on Russian aerospace, hailed the success of Russia's manned Space Station, Mir. He noted that the Mir, launched in 1986, had been continuously occupied since mid-1989 by successive teams of cosmonauts.

According to Oberg, American space engineers who visit Russia's space center have been impressed with the program's "sound, intelligent space hardware." Yet, Oberg noted, the Western press pays very little attention to Russian accomplishments in space. He suggested that awareness of what the Mir had accomplished could be useful in the upcoming round of political debate on whether the U.S. is "too poor to run a manned Space Station." (*CSM*, Mar 1/93)

- Several life science researchers questioned whether a redesigned Space Station would accomplish enough life science objectives to be worth the investment. Researchers at a meeting of the National Research Council's Space Studies Board said that they expected a redesign to either shrink or reduce the centrifuge, a set of spinning modules designed for precise gravity experiments on

animals aboard the station. Harold Guy, a professor at the University of California's School of Medicine in LaJolla, California, said that without a large centrifuge, much of the station's experimental value for life scientists would be lost. "The life science community may bail out," said Fred Turek, a neurobiologist and chairman of the space biology and medicine committee on the National Research Council's Space Studies Board. (*Space News*, Mar 1/93)

- An article in *Space News* on Daniel S. Goldin's decision to remove Leonard Fisk as manager of the Agency's space science program discussed Fisk's managerial style. Last October Goldin changed Fisk's title to chief scientist, a position without management authority. According to the article, many scientists viewed Fisk as synonymous with advocating and delivering quality space science missions; others said that his record for delivering missions on budget and on time was mixed and that NASA could no longer afford to sacrifice cost and schedule to deliver the biggest science possible to space. (*Space News*, Mar 1-7/93)

- Edward Frieman, who served as chairman of the White-House-led Earth Observing System Engineering Review Committee, said that NASA needed to institute an outside review process for its science missions. NASA's internal review process tended to bloat rather than streamline science missions, he said. "They're really not review teams, they're the advocates," said Frieman, director of the Scripps Institution of Oceanography in LaJolla, California. (*Space News*, Mar 1-7/93)

- *Space News* reported that European space officials were monitoring news about the fate of the United States Space Station under the Clinton administration. The 13-nation European Space Agency (ESA) had agreed to spend about \$2.8 billion on its Columbus Space Station program. The European program included a habitable laboratory that was to be attached to the Station and related ground equipment. (*Space News*, Mar 1-7/93)

- Operators of Biosphere 2, the world under glass experiment, named John B. Corliss, a NASA consultant, to head research for the \$150 million private venture. (AP, Mar 1/93)

- *Federal Computer Week* reported that a small woman-owned Florida firm had protested Marshall Space Flight Center's decision to let companies with up to 1,500 employees bid on a small, disadvantaged business (SDB) set-aside program there. Challenger Engineering Inc., St. Petersburg, Florida, maintained that NASA's procurement policy was unfair to smaller minority-owned firms that could not compete with larger companies. (*Federal Computer Week*, Mar 1/93)

March 2: Retired Admiral Thomas H. Moorer, former chairman of the Joint Chiefs of Staff, writing in the *Washington Times*, suggested that using a floating, or "Hydra," launch system would massively lower the cost of space

launches for commercial concerns and break the current space launch bottleneck. Commercial launches now can be preempted by government launches. He noted that the Soviet Navy had used the Hydra technique to launch its nuclear armed ballistic missiles from submarines for more than 25 years. (*W Times*, Mar 2/93)

- French scientists, led by Dr. Jacques Laskar of the Bureau des Longitudes in Paris, writing in the journal *Nature*, and Dr. Jack Wisdom, an astronomer at the Massachusetts Institute of Technology, writing in the journal *Science*, described the implications of chaos in the solar system. New computer simulations have revealed that over great spans of time, small gravitational disturbances from neighboring planets, combined with their own wobbly rotations, can cause significant fluctuations in the orbits and orientations of the planets, leading to, for example, great temperature fluctuations. Mars, for example, is still undergoing great variations. According to scientists, Earth may be spared such variations because of the stabilizing influence of the Moon, the only large satellite in the inner solar system. (*NY Times*, Mar 2/93; *Time*, Mar 8/93)

March 3: Congress held an oversight hearing March 2, in which members of Congress attempted to determine what had led to a potential \$1 billion overrun in the Space Station program. Space Station managers testified on how the overruns had developed and how they planned to fix them. At the hearing, NASA officials said they had offset all but about \$500 million of the potential cost overruns for the next three years; they had done so largely by cutting management jobs and replacing consultants with government employees. (*W Post*, Mar 3/93; *LA Times*, Mar 3/93; *USA Today*, Mar 3/93; *AP*, Mar 3/93; *Space News*, Mar 8-14/93; *AvWk*, Mar 8/93; *H Post*, Mar 3/93)

- NASA announced that when the first U.S. commercial rocket lifts off in May, its main fuselage and booster rocket were scheduled to carry the logo, "Last Action Hero," the title of a Columbia Pictures summer movie release starring Arnold Schwarzenegger. Columbia paid \$500,000 for the ad, which was to be orbiting Earth for more than two years. (*WSJ*, Mar 3/93; *B Sun*, Mar 3/93; *W Post*, Mar 3/93; *LA Times*, Mar 3/93; *USA Today*, Mar 3/93; *UPI*, Mar 3/93; *AP*, Mar 3/93)

- Speaking at the annual meeting of the American Association for the Advancement of Science, George Smoot, an astrophysicist at the Lawrence Berkeley Laboratory in Berkeley, California, described his cosmic research work using the space-time ripples that were discovered a year ago, Smoot and his group want to explore backward in time toward the universe's origin and forward to the universe of today. In its investigation, the group uses one of the instruments on the Cosmic Background Explorer Satellite to study the microwave radiation that permeates the cosmos. Cosmologists now have what Smoot compares to "a baby photograph of the universe at about five hours

into a human lifetime." That snapshot contains enough information to allow investigators to work backward and forward in time. (CSM, Mar 3/93)

- Senator John Warner (R-Virginia), introduced legislation to kill NASA's manned Space Station project. Calling the Space Station "wasteful and unnecessary," the senator urged President Clinton to kill the project. (*W Post*, Mar 3/93, Mar 4/93)

- NASA announced at least a two-day delay in the planned March 14 launch of Space Shuttle Columbia because of a ruptured hydraulic hose that had sprayed fluid in the engine compartment. This was the second delay in three weeks for the German Spacelab mission. (*AP*, Mar 3/93, Mar 4/93; *UPI*, Mar 3/93; *P Inq*, Mar 4/93; *USA Today*, Mar 4/93; *RTw*, Mar 3/93)

March 4: NASA announced that it had chosen the University of Texas Southwestern Medical Center in Dallas to become the NASA Specialized Center of Research and Training in Integrated Physiology. The new center would focus on arriving at a better understanding of how different organ systems of various species react to space flight. (NASA Release 93-040)

- Analysis of measurements from NASA's Earth Radiation Budget Experiment (ERBE) satellite confirmed that Mount Pinatubo's eruption in the Philippines in June 1991 had resulted in a temporary cooling of the Earth that equated to a decrease in global surface temperature of approximately one degree Fahrenheit (0.5 degree Celsius). The data provided the first conclusive evidence of a significant change in global energy caused by a volcanic eruption. (NASA Release 93-41; *P Inq*, Mar 5/93; *B Sun*, Mar 5/93; *NY Times*, Mar 9/93)

March 8: Launch of the Commercial Experiment Transporter (COMET), which was scheduled to lift off March 31, was postponed for at least two months. NASA contributed \$85 million toward three launches of the COMET; the spacecraft was to carry 11 experiments from NASA's commercial space development centers. COMET was also serving as the first space billboard. Columbia Pictures paid \$500,000 to advertise an upcoming Arnold Schwarzenegger movie on the rocket. (*Space News*, Mar 8-14; *AP*, 9/93, Mar 10/93)

- NASA announced that it had awarded Government Technology Services Inc., of Chantilly, a contract to provide Unix work station products to NASA's Goddard Space Flight Center in Greenbelt, Maryland. (*W Times*, Mar 4/93)

- NASA announced that an ER-2 aircraft, an updated version of the U-2 spy plane, would spend seven months next year researching the ozone hole over Antarctica. The study, part of a joint New Zealand-U.S. atmospheric study into ozone depletion, would explore the extent of the hole in the ozone layer. NASA research pilot Jim Barrilleaux was to fly the NASA-owned ER-2 aircraft. The work was scheduled to begin in late March 1994. (*RTw*, Mar 4/93)

March 5: NASA announced that it had postponed the Space Station Freedom Utilization Conference, planned for June 21-24 in San Francisco, California. NASA managers decided to postpone the conference because of recent instructions to redesign the Space Station. (NASA Media Advisory)

- NASA announced that Mae C. Jemison, M.D., the first woman of color in space, had resigned to pursue interests in “teaching, mentoring, health care issues, and increasing participation in science and technology of those who have traditionally been left out.” Jemison, who joined the astronaut program in 1987, was a science mission specialist on STS-47, Spacelab-J, in September 1992, a cooperative mission with the Japanese to study life sciences and materials processing. (NASA Release 93-043; *P Inq*, Mar 7/93; *B Sun*, Mar 7/93; *W Post*, Mar 8/93; *W Times*, Mar 7/93; *AP*, Mar 6/93; *UPI*, Mar 6/93; *USA Today*, Mar 9/93; *People Magazine*, Apr/93)

- Europe’s Arianespace, Inc. announced that it had signed a launch contract for two intelsat VIII satellites. The satellites were to be built by General Electric Corporation’s Astro Space Division and launched in 1996 from a site in French Guiana. (*W Times*, Mar 5/93)

- Daniel S. Goldin, NASA Administrator, attempted to smooth over “strained” relations with top NASA management, upset over a letter that he had written to a House subcommittee investigating space station funding. In part the letter read, “I have been concerned with regard to the validity of the present cost and schedule estimates.” NASA officials scheduled to testify before the subcommittee said that Goldin’s comments seemed to discredit what they had to say even before they said it. Yesterday, Goldin denied that he distrusted his top managers. (*W Post*, Mar 5/93)

- The French National Space Agency announced that Western Europe’s first Ariane-5 solid-fuel rocket booster had undergone successful tests at a launch center in French Guiana. (RTw, Mar 6/93)

March 7: Atmosphere researchers urged government science agencies to speed up their evaluation of the large pilotless drone called the Condor, fearing that the aircraft would be scrapped if the government did not buy it. The drone, which cost an estimated \$300 million, was built as a prototype spy aircraft for the Pentagon by Boeing Corporation. It can fly more than 20,000 miles without refueling. Converting the drone from military to civilian use would cost an estimated \$70 to \$100 million. (*NY Times*, Mar 7/93)

March 8: The Los Angeles Chamber of Commerce announced that it had awarded NASA Administrator Daniel S. Goldin, U.S. Air Force Lt. General Edward Barry, and the Jet Propulsion Laboratory (JPL) its Kitty Hawk, Sands of Time Award. The chamber annually recognizes individuals and companies

in the aerospace industry as a means of promoting the industry. (*Space News*, March 8-14/93)

- General Dynamics Space Systems Division of San Diego proposed returning to the Moon for a 21-day, two-person mission in 1999. The mission would use a capsule and return vehicle transported by the U.S. Space Shuttle and a Titan 4 rocket with a Centaur upper stage; the proposal did not call for the construction of a new launcher. However, NASA's head of exploration called many of the calculations in the proposal overly optimistic. NASA's own rough draft for a lunar base program entailed construction of a new launcher and higher costs than those projected in the General Dynamics proposal. (*Space News*, March 8-14/93)

- NASA announced that a hydraulic hose that ruptured in Columbia's engine compartment during a launch-pad test had a manufacturing defect; the defect was also found in nine other lines in the Shuttle. The problem delayed Columbia's German Spacelab mission, scheduled for March, by at least five days. (AP, Mar 8/93)

- Clinton administration officials said that the fate of the U.S. Space Station depended on finding a new design that would not absorb NASA's entire budget. Dr. John H. Gibbons, head of the Office of Science and Technology Policy in the White House, said that the administration had ordered the redesign after it discovered that the rising costs of the project threatened all the other civilian space and aeronautics research programs. (AP, Mar 8/93, Mar 9/93; *W Times*, Mar 9/93; *USA Today*, Mar 9/93; *AvWk*, Mar 8/93)

- *Aviation Week & Space Technology* reported that Lockheed was leading a six-member industry team in an effort to develop an unsolicited National Aero-Space Plane (NASP) proposal for the Air Force. The team was to recommend scrapping the NASP in favor of a much lighter hypersonic research vehicle called NORA, for National Orbital Research Aircraft. NORA's \$5 billion price tag was far less than the \$10-15 billion slated for the NASP. (*AvWk*, Mar 8/93)

March 9: The *Washington Post* reported that Sally K. Ride's name kept coming up as a possible candidate to run NASA but that Ride had apparently said that she was not interested in the job. (*W Post*, Mar 9/93)

- NASA awarded the Arlington, Virginia-based Analytic Services Inc. a one-year grant to help study opportunities for cooperation among nations with space programs. (*W Times*, Mar 9/93)

- Two Russia cosmonauts training for a U.S. Shuttle flight said that they were eager to try out America's spaceship. The two cosmonauts had two and one-half years of space experience between them. (AP, Mar 9/93; *W Times*, Mar 10/93)

March 11: NASA Administrator Daniel S. Goldin announced a number of organizational changes in the Agency. He named John R. Dailey to be acting Deputy Administrator and said that Dr. Joseph Shea, recently named as Assistant Deputy Administrator for Space Station Analysis, would have oversight over all Space Station related development activities.

Goldin also reorganized the Agency's science divisions: Harry C. Holloway, deputy dean of the Uniformed Services University of the Health Sciences in Bethesda, Maryland, was scheduled to become NASA Associate Administrator of the new Life and Microgravity Science office. Assisting him was to be Bonnie J. Dunbar, a NASA astronaut, who has a doctorate in biomedical engineering. Others named included Deidra A. Lee, appointed Associate Administrator for Procurement. (NASA Release 93-044; *W Post*, Mar 15/93; *Space News*, March 16-21)

- The first flight of NASA's Small Expendable-tether Deployer System (SEDS) was scheduled to be launched aboard a U.S. Air Force Delta 2 rocket from Cape Canaveral Air Force Station, Florida, no earlier than March 18. The SEDS tether system would be a secondary payload on the Delta 2 launch vehicle. (NASA Advisory, Mar 11/93)

- NASA announced that the Galileo spacecraft's main antenna remained jammed following an increase in the spacecraft's spin rate, a maneuver that was executed as a test for a future mission but also had a possibility of releasing the stuck antenna. NASA gave up any real hope of fixing the problem in January after hitting the stuck antenna dish 13,320 times with motors that were designed to open the device.

The jammed antenna was expected to hamper the ship's \$1.4 billion mission to Jupiter because the spacecraft would have to use a much smaller antenna dish to transmit data. NASA said it expected to accomplish 70 percent of the mission's scientific goals. (*AP*, Mar 11/93)

- Officials at NASA's Jet Propulsion Laboratory in Pasadena, California, announced that an SR-71 Blackbird reconnaissance aircraft, once used as a spy plane, took off this week on its maiden science flight. The plane was equipped with an ultra-violet camera to study stars and comets.

The plane, one of six planes decommissioned by the Air Force two years ago and turned over to NASA, was operated by NASA's Dryden Flight Research Facility and was expected to be flown an average of once a month for the rest of the year. (NASA Release 93-071; *RTw*, Mar 11/93; *AP*, Mar 22/93; *Antelope Valley Press*, Mar 13/93)

March 12: Daniel S. Goldin, NASA Administrator, announced that following a White House directive, NASA had begun a redesign of the proposed Space Station to make it simpler, smaller, easier to build, and cheaper to operate. The redesign team planned to present three proposed models to the Clinton admin-

istration by June 1. Goldin said that the Agency would make maximum use of the \$8.5-billion worth of work that had gone into designing and planning the Space Station since the mid-1980s. (*NY Times*, Mar 12/93; *W Times*, Mar 12/93; *LA Times*, Mar 12/93; *B Sun*, Mar 12/93; *AP*, Mar 11/93, Mar 12/93; *WSJ*, Mar 12/93; *Space News*, Mar 15-21; *AvWk*, Mar 15/93; *H Post*, Mar 8/93, Mar 12/93)

- Henry Knight Bradford, 88, a retired engineer with NASA's Goddard Flight Center, died March 10 in California. He had Parkinson's disease. Mr. Bradford joined NASA in 1960; he retired in 1972. (*W Post*, Mar 12/93)

March 13: NASA announced a March 21 launch date for Columbia's German spacelab mission. The launch was delayed twice because of mechanical problems with the Shuttle. (*P Inq*, Mar 13/93; *W Post*, Mar 14/93; *UPI*, Mar 12/93, Mar 13/93; *RTW*, Mar 12/93)

March 14: According to a report in Reuters, the Arianespace consortium continued to be the world leader in number of commercial satellite launches. Ariane filled the void when NASA stopped launching commercial payloads after the Space Shuttle Challenger exploded in January 1986. U.S. launchers, especially the General Dynamics Atlas series, which has the capacity to launch large payloads, were fighting for each launch contract. (*RTW*, Mar 14/93)

March 15: Researchers writing in the current issue of the journal *Nature* announced that they had detected a guitar-shaped nebula attached to the fastest known star in the galaxy; the star is at the tip of the neck of the "guitar." The speed of the star, a pulsar, which scientists calculated travelled at least 500 miles per second through the Milky Way galaxy, created a "bow-shock" wave in the rarified gas of outerspace. The shockwave heated the gas it encountered and made it give off energy, now appearing as the outline of the star's wake. The wake was detectable only with the world's most powerful telescope, according to Cornell University astronomer James M. Cordes. (*W Post*, Mar 15/93; *Time*, Mar 22/93)

- Speaking to a meeting of the American Astronautical Society, Representative Alan Mollohan warned that unless NASA could prove it contributed to U.S. economic competitiveness, politicians would view it as a "cold war anachronism." According to an article in *Space News*, Mollohan's comments reflected the view of both the White House and members of Congress. The message: change or become irrelevant. (*Space News*, March 15-21)

- Europe, Japan, and Canada—the United States's partners in the Space Station project—rejected NASA's move to redesign the project. They instead demanded that the team begin by considering revisions to the current plan. They warned that they might be forced to pull out of the program if the United States changed the plan significantly. (*Space News*, March 15-21/93)

- According to *Space News*, in a March 10 letter to Vice President Gore, Senator Howell Heflin, D-Alabama, argued against canceling the Advanced Solid Rocket Motor program. Heflin said he opposed a proposal to close the rocket motor plant in Iuka, Miss.; those opposing the closing hoped that the plant eventually would be used to build a hybrid rocket motor for a National Launch Center. (*Space News*, March 15-21/93)

- Representative George E. Brown Jr, chairman of the House Committee on Science, Space, and Technology, warned the Clinton administration that ordering a redesign of the Space Station might doom not only the Space Station but also other international "big science" projects. He also sent a letter to NASA Administrator Daniel S. Goldin cautioning him against abandoning the current design, which had cost \$8 billion so far. (*W Post*, Mar 16/93)

March 16: NASA announced that under a recently signed agreement NASA engineers and Learjet Inc. engineers, based in Wichita, Kansas, would work on the development of a new high performance business jet. The engineers were to study aircraft size and aerodynamics to create the plane; they would use state-of-the-art supercomputers and wind tunnels at NASA's Ames Research Center, Mountain View, California. (NASA Release 93-46; AP, Mar 15/93)

- NASA and the seven Central America nations began a program to study, preserve, and protect the region's rain forest by expanding the use of satellite data by Central American scientists. Under an agreement with the Central American Commission for Environment and Development, NASA would train and provide equipment to scientists from all the Central American countries. By using data from the Advanced Very High-Resolution Radiometers flying aboard several U.S. weather satellites, the scientists would be able to estimate the amount and type of vegetation cover and forest cover in the region and to conduct costal studies. (NASA Release 93-47)

March 16: NASA announced that NASA personnel had moved the Space Shuttle Discovery to the launch pad on Monday, March 15. Discovery was scheduled to be launched in April on an atmospheric research mission. Meanwhile preflight work resumed on Columbia, which was scheduled to be launched in less than a week. (*W Times*, Mar 16/93; *USA Today*, Mar 16/93; AP, Mar 15/93)

- G. Joseph Minetti, 85, died of heart failure on March 13. He served on the Civil Aeronautics Board for 22 years, leading the panel during years of enormous expansion and change in the aviation industry. (*W Post*, Mar 16/93)

- The Clinton administration announced that it had launched a complete review of U.S. policy toward cutting global-warming pollution, but had not yet abandoned the stance taken by the Bush administration. (*B Sun*, Mar 16/93)

March 17: NASA and the European Space Agency (ESA) were cooperating on an experiment that involved three spaceships "listening" for passing gravitational waves. The spaceships, now travelling to separate destinations in the solar system, were NASA's Mars Observer, Galileo, and the ERS's Ulysses spacecraft.

Such waves of gravity have never been directly detected, although their existence was predicted decades ago in Einstein's theory of relativity. The joint NASA-ESA experiment would be the first time three spacecraft would make observations simultaneously, thus greatly increasing the reliability of any detection. (NASA Release 93-38; AP, Mar 22/93)

March 18: The *Washington Post* reported that a subcommittee of the House Administration Committee had approved the extension of the National Air and Space Museum at Washington Dulles International Airport. The two bills were forwarded to the full committee. The legislation called for an appropriation of \$8 million in fiscal year 1994 for the start-up of the air and space extension. (*W Post*, Mar 18/93)

- A spokesman for Lawrence Livermore National Laboratory in California said that a pressure buildup ripped apart an experimental supergun designed to fire objects into space. The accident delayed a demonstration scheduled for this spring. Scientists hoped to use the gun, which is like an enormous air rifle, to shoot payloads into space at a fraction of the cost of sending them into orbit via a Space Shuttle. (AP, Mar 18/93; *USA Today*, Mar 18/93;

- NASA announced that 14 astronauts who orbited the Earth during Project Gemini were installed in the U.S. Astronaut Hall of Fame. The new inductees were John W. Young, James A. McDivitt, the late Edward H. White II, Charles Conrad Jr., Frank Borman, James A. Lovell, Thomas P. Stafford, Neil A. Armstrong, David R. Scott, Eugene A. Cernan, Michael Collins, Richard F. Gordon Jr., and Buzz Aldrin. (UPI, Mar 18/93, March 22/93; Reuters, March 22/93; AP, Mar 22/93; *P Inq*, Mar 21/93)

- Astronauts aboard the Space Shuttle Columbia were to be injected with a saline solution and wired with catheters during next week's research mission in an attempt to help doctors understand the effects of weightlessness on the body. The two German astronauts on board would also have catheters in their veins during the launch in order to measure blood pressure.

Eighty-eight experiments involving 200 scientists from around the world were planned during the nine-day German-sponsored research flight. All the science would be managed from a control center in Germany. NASA was scheduled to handle everything else. (AP, Mar 18/93; Reuters, Mar 17/93)

- NASA was scheduled to launch an unmanned Delta rocket with a military navigation satellite and NASA's tagalong tether experiment. The 12 1/2-mile tether, which is just three-hundredth of an inch thick—is wound around a

spool. One end of the cord is tied to a 57-pound aluminum box. Everything is mounted on the rocket's second stage. NASA planned to pop the box off the spent booster an hour after the launch. As it shoots away, the box should cause the tether to unwind. Instruments on board would record the speed and tension of the tether and send the data to Earth. (AP, Mar 18/93)

- NASA said that the Mars Observer spacecraft fired four of its 24 thrusters as a means of adjusting its course so it could begin orbiting Mars on August 24. This was the third correction maneuver since the spacecraft was launched September 25 from Cape Canaveral, Florida. (APn, Mar 18/93)

- In its annual report, NASA's Aerospace Safety Advisory Panel said that the Space Station had "progressed considerably in the past year." The report went on to say that the effort "exhibits a degree of stability and continuity that has previously been absent." (APn, Mar 18/93)

March 19: NASA announced that Leonard Nicholson was leaving his position as Space Shuttle program manager to assume the position of acting Director of Engineering at Johnson Space Center, Houston, Texas. Brewster Shaw, currently NASA's deputy shuttle director, was scheduled to take over the duties formerly performed by Nicholson. (NASA Release 93-49; AP, Mar 22/93)

- NASA announced that the Agency had selected GE Government Services, Houston, to begin final contract negotiations for the Science Payloads Development, Engineering, and Operations Contract. (NASA Release C93-d)

- NASA announced that bad weather had forced the military to postpone launch of a rocket scheduled to unfurl a tether in space and that the delay had forced NASA to bump the launch of Shuttle Columbia from Sunday to Monday. (RTw, Mar 19/93; AP, Mar 19/93; UPI, Mar 19/93; W Post, Mar 19/93)

March 22: NASA's Lewis Research Center, Cleveland, and the Ohio Aerospace Institute were scheduled to host a conference in Cleveland, March 30 and 31, focusing on the new world of cyberspace. The conference, called the Vision 21 Symposium on Interdisciplinary Science and Engineering in the Era of Cyberspace, would provide "a panoramic view of the research and technology that will assist humans in exploration activities," said Dr. Sheila Bailey, conference chairperson. (NASA Release 93-50)

- After a month of delays, NASA prepared for launch of the Shuttle Columbia's German mission. Forecasters were predicting a 70 percent chance of favorable liftoff conditions. The flight would be Columbia's fourteenth in 12 years.

The Shuttle was to take two German physicists into orbit to perform low gravity experiments inside the cargo bay of the \$1 billion research module spacelab. Five NASA astronauts were to accompany them on the nine-day flight. The German-sponsored research program touched a wide range of fields, from electronics and fluid physics to biology and astronomy. The astronauts also planned to test a robot arm mounted in the Spacelab module. (*P Inq*, Mar 22/93; *W Times*, Mar 22/93; UPI, Mar 22/93; Reuters, Mar 22/93; AP, Mar 22/93)

- The Freedom Forum, a group that funds journalism programs, presented a \$100,000 grant to the Mercury Seven Foundation to establish a lecture series about space. The series, which was intended to help improve public understanding of space issues, was to be held annually in Florida's Brevard County, the location of the Kennedy Space Center. (AP, Mar 22/93)
- The Air Force cancelled its planned launch of a rocket with a navigation satellite and tether experiment because of problems with ground support equipment. A damper on the launch pad became stuck in the final minutes of Friday's countdown, causing rocket valves to freeze. Although workers fixed that problem, the temperature of the helium needed to pressurize the fuel tanks did not rise back up fast enough to permit the launch. (AP, Mar 22/93)
- NASA announced that it had banned news organizations from covering meetings about the redesign of Space Station Freedom. NASA said the meetings would be closed because they involved mainly NASA employees, not outside advisers. NASA has formal advisory committees, which meet openly in compliance with a 1972 law governing such meetings. (*Space News*, March 22-28/93)
- A NASA safety panel reported that inspection of recovered Space Shuttle solid rocket motors had found traces of soot on O-rings and recommended a redesign of one of the motor's main joints. The Aerospace Safety Advisory Panel (ASAP) warned NASA on March 18 that the possibility of a problem was "sufficiently high" to warrant the joint's redesign. (*Space News*, Mar 22/93)
- According to a report in *Space News*, NASA and White House officials agreed last week to consider partner concerns about the Space Station design effort. The U.S. government would give their European, Japanese, and Canadian partners greater representation in the project and ensure that any alternative design did not exclude their hardware. The agreement was laid out in a March 19 document. (*Space News*, Mar 22-28/93)
- According to a report in *Space News*, senior NASA managers testified about cost increases in a March 17 hearing called by Representative Louis Stokes (D-Ohio), chairman of the House appropriations subcommittee that has NASA oversight. The subcommittee examined in detail six NASA projects that cost far more than the Agency estimated originally: Advanced Solid

Motor, Advanced Turbopump, Transfer Orbit Stage, Mars Observer, Space Station, and the Space Shuttle waste collection system.

Daniel S. Goldin promised the subcommittee that he would press forward with management reforms to battle the cost growth seen in many Space Agency projects. In return, the chairman of the committee signalled Congress' willingness to provide NASA with a lump sum covering several years—rather than just annual appropriations—to conduct some space science efforts. (*Space News*, Mar 22-28/93; *AvWk*, Mar 22/93)

- According to *Space News*, seven months after a NASA-appointed Management Review Team reported that lax security had created a high risk of espionage at the Ames Research Center in Northern California further investigations by the FBI and NASA's inspector general had not substantiated those charges. In the meantime, however, Ames had implemented many of the team's recommendations. (*Space News*, Mar 22-28/93)

- *Space News* reported that congressional lawmakers who supported NASA's Space Station were attempting to stop the White House from scaling back the program. Democrats appeared to be seeking a compromise while Republicans were threatening a public fight. (*Space News*, Mar 22-28; *AvWk*, Mar 22/93)

- NASA reported that the launch of Space Shuttle Columbia had been halted three seconds before liftoff because of a main engine failure caused by a malfunctioning engine valve. When the Shuttle's computers detected a faulty valve, the safety system shut down the Shuttle's main engines. Officials stressed that the crew on the \$1 billion German-charted research mission was never in any danger because of the aborted liftoff. Repairs were expected to take about three weeks. The shutdown was the third launch pad abort in Shuttle program history. (Reuters, Mar 22/93, Mar 23/93; AP, Mar 22/93; UPI, Mar 22/93; *B Sun*, Mar 23/93; *P Inq*, Mar 23/93; *CSM*, Mar 23/93; *NY Times*, Mar 23/93; *USA Today*, Mar 23/93; *W Post*, Mar 23/93; *W Times*, Mar 23/93; *WSJ*, Mar 23/93)

- In a *Space News* interview, John Gibbons, Director of the Office of Science and Technology, defended the White House decision to require NASA to redesign the Space Station; he also said that he did not think that space would have a lower priority in the Clinton administration as a result of the space council's being folded into the Office of Science and Technology. Among other topics, the interview touched on whether NASA would handle commercial and military, as well as civilian, space issues; how space issues would be coordinated among Federal agencies; Earth observation programs; and the function of a Space Station. (*Space News*, Mar 22-28/93)

- An article in *Aviation Week & Space Technology* reported that Europe was about to decide how to parcel out \$1.5 billion in new science and exploration space missions. Roger Bonnet, director of science at the European Space

Agency (ESA), was reported as saying that ESA would focus on "all European" programs in order to distance itself from the troubles and uncertainties of space cooperation with the U.S. He noted, "We will now study missions in the context of a European framework to be sure we can handle them in ESA, then define cooperation afterward."

The biggest European decision would focus on development of a \$600-700-million infrared telescope that could detect the most primitive matter in the universe and Project Rosetta, an \$800-million mission that would be the first to sample the surface of a comet. (*AvWk*, Mar 22/93)

March 24: NASA announced that the most recent findings by the Pioneer Venus Orbiter spacecraft strongly suggested that planet Venus once had three and a half times more water than thought earlier—enough water to cover the entire surface between 25 and 75 feet deep. The findings supported the possibility of the presence of lightning on Venus and discoveries about the ionosphere and top of the atmosphere of Venus. Venus, considered Earth's twin planet, is today very dry and hot. (NASA Release 93-51)

- NASA named Alphonso V. Diaz as the Deputy Associate Administrator for the Agency's new Office of Space Science, effective immediately. During his career at NASA, Diaz served as Deputy Associate Administrator for Space Science and Applications, managed the Galileo and Ulysses programs in the Solar System Exploration Division, and developed space science programs for Space Station Freedom. (NASA Release 93-53)

- Scientists reported that a periodic comet named Swift-Tuttle might hit Earth on August 14, 2126. Later calculations suggested that Swift-Tuttle would not be a threat on that date but would be a definite threat in 3044. (*Smithsonian Magazine*, March/93)

- The *Washington Post* reported that Maxime Faget, chairman and founder of Space International Inc., had resigned from his position as consultant to the Space Shuttle redesign team. Some NASA employees questioned Faget's objectivity because his company had earlier proposed its own alternative Space Station and design and because the company would likely bid on any new design proposal. Faget's resignation "was determined by both NASA and Space Industries as necessary." (*W Post*, Mar 24/93)

- NASA unveiled a \$300 million radar system that can take color pictures of Earth's damaged environment from a Space Shuttle. According to NASA project scientist Diane Evans, "In many cases, radar is the only way scientists can explore inaccessible regions on Earth's surface." The camera was scheduled to fly on the Shuttle three times, in 1994, 1995, and 1996. NASA and the German and Italian space agencies cooperated on the project. NASA paid half the cost. (*AP*, May 14/93)

- NASA removed scientific samples and volatile fuels from the Space Shuttle Columbia on Tuesday. The Shuttle was grounded for at least three weeks because of an engine shutdown that had occurred three seconds before liftoff. (AP, Mar 24/93; UPI, Mar 24/93)

March 25: NASA announced that the Langley Research Center, Hampton, Virginia, would lead a multi-year research program effort to develop technology for a future high-speed civil transport. According to Louis Williams, Director of the High-Speed Research Division, NASA Headquarters, Washington, D.C., "The program is laying a technical foundation for an environmentally compatible, economically practical commercial transport that could contribute up to 140,000 jobs and \$200 billion to the national economy in the next century." (NASA Release 93-52; *Daily Press*, May 24/93)

- NASA Administrator Daniel S. Goldin announced that the activities of the Office of Exploration would be absorbed by the Office of Space Science, effective immediately. (NASA Release: 93-54)

March 29: *Federal Computer Week* recognized three NASA employees for their work in procurement. Don Lovall, chief, Technical and Information Systems, Design Engineering Directorate at the NASA Kennedy Space Center, was recognized, together with his team, for awarding the Personal Computer Acquisition Contract (PCACP), an innovative contracting vehicle and NASA's first consolidated microcomputer buy. PCAC was unusual because it fostered competition among three chosen vendors throughout its five-year life. Skip Kemere, ADP procurement branch chief, NASA Goddard Space Flight Center, was also recognized. He devised NASA's winning strategy in the SEWP BOWL, its first Agencywide buying vehicle for high-powered work stations. Darleen A. Druyun, Associate Administrator for Procurement at NASA, was recognized for her action on the awarding of NASA's Earth Observing System Data and Information System core contract. Instead of accepting low-ball bids from major firms, she sent the bids back to the bidders and asked that they be adjusted—upward—to reflect more realistic costs. (*Federal Computer Week*, Mar 29/93)

March 30: NASA announced that it had awarded a contract to Hughes Applied Information System, Inc., Seabrook, Maryland, to design, develop, integrate, maintain, and operate the NASA Earth Observing System Data and Information System (EOSDIS) Core System. The system would support the acquisition, processing, archiving, and distribution of data from U.S. Earth-observing spacecraft. NASA estimated that thousands of scientists around the world would eventually study and analyze data provided by the new system. (NASA Release 93-56; *W Post*, Apr 1/93)

- NASA announced that the Ames Research Center, Moffett Field, California, and California wine growers would use aerial and satellite images to

battle an insect problem encountered by California's wine industry. Sensitive electronic scanners on aircraft and satellites would help a group from government, industry, and several universities map and analyze root louse damage in northern California's wine growing region this summer. (NASA Release 93-55; UPI, Mar 31/93; *SF Chron*, Mar 31/93; *P Inq*, May 2/93)

- A Delta 2 rocket successfully ejected a television-size satellite on 12 and 1/2 miles of cord. The experiment demonstrated that tethers could be used to deploy small payloads in space, NASA said. The tether, which was thin as a kite string, dangled the 57-pound box for 90 minutes at an altitude of 450 feet. (*W Post*, Mar 31/93; *NY Times*, Mar 31/93; *P Inq*, Mar 31/93)

- NASA announced that the Space Shuttle Discovery would be sent on its eight-day atmospheric research mission next week, pushing Columbia's German-sponsored science flight into late April. The Columbia was scheduled for launch April 24. (UPI, Mar 30/93; *W Post*, Mar 31/93; *RTw*, Mar 31/93)

April

April 1: NASA announced that findings by scientists at NASA's Ames Research Center, Moffett Field, California, challenge the theories of how galaxies evolve. The U.S. team included a scientist from the Max Planck Institute, Heidelberg, Germany.

Scientists observed huge amounts of microscopic diamonds in star-forming clouds in the Milky Way Galaxy. They also observed softer hydrocarbons in the thin space between clouds. The observations of these two independent and very different types of interstellar hydrocarbon dust suggest that the materials are not mixing as generally assumed. Lou Allamandola, head of the science observation team, said that the "team's observations support the theory that meteoritic diamonds form in many regions of space, either in carbon star atmospheres or as the result of carbon grains colliding at high speeds in interstellar space." (NASA Release 93-58; *Time*, Apr 12/93; UPI, Apr 12/93; AP, Apr 4/12)

- NASA named representatives from government and industry and academic experts from across the country to take part in an independent review of NASA's Space Shuttle redesign options. A total of 16 individuals were invited to serve on the committee. Charles M. Vest had previously been named by Vice President Albert Gore to head the Advisory Committee on the Redesign of the Space Station. The Advisory Committee was to submit its recommendations in June. (NASA Release 93-59)

- NASA announced that April marked the 10th anniversary of NASA's Tracking and Data Relay Satellite System (TDRSS), a space-based network developed to meet telecommunications needs of Space Shuttle, Space Station, and other low Earth-orbiting spacecraft missions. The TDRSS is equipped to support up to 24 user spacecraft, including the Space Shuttle, simultaneously. (NASA Release 93-60)

- NASA spokeswoman June Malone said a broken pin was responsible for a leaky engine valve removed from Space Shuttle Discovery, scheduled to lift off on an atmospheric research mission next week. The alignment pin broke while technicians were removing plumbing from around the valve for leak tests ordered after the March 22 main engine shutdown of Columbia. (AP, Apr 1/93)

April 2: NASA and the Russian Space Agency (RSA) announced that Sergei K. Krikalev would be the prime mission specialist and Vladimir G. Titoyov the backup mission specialist on the STS-60 mission currently scheduled for launch in November 1993. The two cosmonauts had been in mission specialist training at NASA's Johnson Space Center, Houston, since early November 1992. (NASA Release 93-61)

- NASA and the Russian Space Agency (RSA) announced that they had signed a contract to fly two U.S. Mars Oxident Experiment (MOX) instruments on the Russian Mars '94 Mission. The contract had a potential value of \$1.5 million. The Mars '94 Mission, scheduled to be launched in November 1994, would deploy small landing stations and penetrators and carry instruments to study the surface and atmosphere of Mars. (NASA Release 93-62)

April 3: The Itar-Tass news agency reported that the United States and Russia planned a joint mission to Mars in October of 1994. According to the report, the Russian Space Agency and NASA signed an agreement on the Mars-94 project late last year. Scientific equipment on board a Russian spacecraft would include two small landers with probes for analyzing the Martian surface and atmosphere. The oxidization capability of the Martian soil would also be measured, Tass said. (RTW, Apr 4/93)

- The Space Shuttle Discovery, with five astronauts on board, was scheduled to lift off at 1:32 a.m. April 6 to study the condition of the Earth's ozone layer and sample 30 to 40 other gases. Three instruments in the Shuttle cargo bay would measure ozone, and four others would probe solar energy. A nighttime launch was necessary to put Discovery on the desired course for observing sunrises in the Northern Hemisphere. Meteorologists predicted an 80 percent chance of good weather. (*W Post*, Apr 5/93, Apr 6/93; *W Times*, Apr 5/93; *LA Times*, Apr 5/93; *NY Times*, Apr 4/93; *AP*, Apr 5/93; *UPn*, Apr 3/93; *RTw*, Apr 3/97)

- Astronaut Ellen Ochoa, scheduled to be aboard the Space Shuttle Discovery when it was launched in April, would be the first Hispanic female to fly in space. Ochoa, an expert with the Shuttle's 50-foot-long robot arm, was scheduled to deploy and retrieve a \$6 million spacecraft while on the mission. (*FL Today*, Apr 3/93)

April 4: According to an article in the *Washington Times*, scientists from NASA and the National Science Foundation were using the Antarctica as a model for Mars in the Antarctic Space Analog Program. The program used the harsh Antarctica terrain to test technology and techniques that might work on Mars. Sophisticated robots, already being used in Antarctica, would pave the way for human exploration of Mars. A spaceflight may carry a small robot to Mars as early as 1997. (*W Times*, Apr 4/93)

April 5: NASA reported that the new joint U.S.-French TOPEX/Poseidon satellite had observed giant waves measuring up to 40 feet high in the North Atlantic on March 14. The satellite's mission was "to study the dynamics of the currents of the world's oceans by measuring the sea level using a radar altimeter." (*W Post*, Apr 5/93)

April 6: NASA announced that NASA scientists had direct evidence that red supergiants—the largest stars known—end their existence in massive explosions known as supernovae. Until this week, astronomers could only speculate that these explosions represented the death of such stars. NASA's International Ultraviolet Explorer (IUE) satellite obtained the new evidence through observations of a new supernova on March 30. (NASA Release 93-63)

- John H. Gibbons, Director, Office of Science and Technology Policy, outlined to the members-designate of the Advisory Committee on the Redesign of the Space Station, three budget options. The three options are a low option of \$5 billion, a mid-range option of \$7 billion, and a high option of \$9 billion. Each option would cover the total expenditures for the Space Station from fiscal year 1994 through 1988. (NASA Release 93-64)

- Bryan O'Connor, a former astronaut and Deputy Director of the Redesign Team and Deputy Associate Administrator of the Office of Space Flight at NASA, said that NASA engineers planned to have three new design options ready by June. O'Connor said that two plans could cut the cost of the project by 50 percent or more. The third plan, which would be based on the current Space Station Freedom concept, would cost more. Whether the redesign effort could be done quickly and cheaply was still in doubt, O'Connor said. (AP, Apr 6/93; W Post, Apr 6/93)

- *The Wall Street Journal* reported that NASA's Langley Research Center in Hampton, Virginia, was searching for an easy-listening sonic boom. The search was a key part of early U.S. research efforts to design a new airliner to fly twice as fast as sound.

Sitting inside a foam-lined cinder-block box the size of a toddler's playhouse, more than 30 volunteers were being paid \$30 for the afternoon to judge how "annoying" different sonic booms were compared to other aircraft noise. If researchers can solve the sonic boom problem, the economic rewards could be significant. (WS Journal, Apr 6/93)

- An article in the journal *Nature* reported that when the European-American spacecraft Ulysses flew by Jupiter in February 1992, it detected puffs of planetary dust coming from the planet. Six times an instrument on Ulysses recorded bursts of tiny dust grains striking the craft, coming at intervals of about 28 days. The same spacecraft also discovered dust grains from beyond the solar system in the environs of Jupiter. (NY Times, Apr 6/93)

- An article in the *Washington Post* discussed the failed launch of the 14-story Atlas-Centaur rocket from Cape Canaveral, Florida on March 25. The rocket partially lost power 24 seconds after liftoff and sent its military communications satellite into a useless orbit. This was the third problem-filled General

Dynamics launch in two years. Future launches were placed on hold until completion of investigation of the failed launch. (*W Post*, Apr 6/93)

- The launch of Space Shuttle Discovery's eight-day scientific mission, scheduled for 2:32 a.m. April 6 from Cape Canaveral, Florida, was aborted 11 seconds before liftoff when computers detected a problem. It was the second aborted launch in two weeks for the Shuttle program. The previous launch, involving the Shuttle Columbia, was halted three seconds from liftoff on March 22.

The likely cause of the shutdown was a computer circuit problem. Computer data indicated a valve had not closed in Discovery's main propulsion system, raising the danger of a hydrogen fuel spill and a possible explosion. Engineers, however, believed that the valve had closed properly and that a faulty sensor switch or broken wire prevented that information from being received by the on-board computers. NASA hoped to launch Discovery on April 8. (*AP*, Apr 6/93, Apr 7/93; *UPN*, Apr 4/93; *W Post*, Apr 7/93; *NY Times*, Apr 7/93; *W Times*, Apr 7/93; *B Sun*, Apr 7/93; *UPI*, Apr 7/93)

- John H. Gibbons, director of the White House's Office of Science and Technology Policy, said that the United States and its International Space Station partners—Europeans, Canadians, and Japanese—have agreed to give "full consideration" to use of Russian space technology and experience in the redesign of the American Space Station Freedom. Gibbons said that Russian help would be requested "on an as-needed consulting basis" if NASA found that Russian expertise and equipment could save money for the United States. Russia had been operating the Space Station Mir for more than a decade. (*W Post*, Apr 7/93, Apr 13/93; *NY Times*, Apr 7/93, Apr 8/93, Apr 11/93, Apr 13/93; *LA Times*, Apr 7/93; *AP*, Apr 6/93; *Reuters*, Apr 6/93; *CSM*, Apr 8/93; *RTW*, Apr 11/93; *P Inq*, Apr 13/93; *B Sun*, Apr 13/93)

- The *New York Times* reported that a new exploding star, or supernova, was discovered on March 28 by an amateur astronomer in Spain. The new supernova lies about 12 million light years from the Earth. Describing the supernova, Dr. Alex Filipenko of the University of California at Berkeley, said, "This is the brightest supernova explosion the Northern Hemisphere has seen since 1937." Scientists hoped that the star would provide more clues to the universe. (*NY Times*, Apr 7/93; *W Post*, Apr 12/93; *AP*, Apr 5/93, Apr 13/93; *RT*, Apr 12/93; *APn*, May 5/93)

April 8: In a speech delivered April 2 in Washington, DC, at the annual conference of the National Association for Equal Opportunity in Higher Education, Daniel S. Goldin, NASA Administrator, outlined what NASA was doing to emphasize cultural diversity within the organization.

In the address, Goldin announced a plan to double support for Historically Black Colleges and Universities. He also said that the agency had set a goal of

awarding at least eight percent of its contracts to small and disadvantaged women-owned businesses by 1994, that the Agency had established a \$310 million set-aside for high-tech work by small and disadvantaged firms, and that the Agency would sponsor 27 conferences for small and disadvantaged businesses in 22 cities this year. In addition, he outlined Agency incentives for the space industry to exceed small and disadvantaged business subcontracting goals. (NASA Editor's Note N93-19)

- NASA announced details of regional meetings planned for April under the auspices of the White House Technology Reinvestment Project. NASA was scheduled to collaborate with other government agencies in a \$471 million interagency effort to develop dual-use technologies and to help small defense firms make the transition to commercial manufacturing projects. (NASA Release 93-65)
- NASA awarded the Applied Research Corporation, a Landover, Maryland, high-tech firm, a one-year, \$95,401 contract to study archival ultraviolet and infrared data. (*W Times*, Apr 8/93)
- Scientists at a Global Warming Conference warned that global warming might unleash a variety of deadly diseases on the world population. The scientists said that outbreaks of malaria, cholera, diseases born by various parasites, dengue, and yellow fever, and other potential epidemics were likely to become more common if the burning of fossil fuels enhanced the greenhouse effect and heated the Earth. (*B Sun*, Apr 8/93)
- Shuttle Discovery lifted off from Cape Canaveral, Florida, at 1:29 a.m., ET, on an eight-day mission to study Earth's endangered ozone layer. Thursday's liftoff followed an earlier aborted launch. According to reports, the Shuttle, which carried a crew of five, lit up the night like a huge blowtorch as it rocketed into orbit. (*AP*, April 4/93; *RT*, Apr 8/93; *RTW*, Apr 4/93; *UPI*, Apr 4/93; *USA Today*, Apr 8/93; *W Post*, Apr 8/93; *B Sun*, Apr 8/93)
- Shuttle astronaut Mae Jemison was scheduled to make a guest appearance on a "Star Trek: The Next Generation" episode during the week of May 31. Very much in demand as a speaker when she was with NASA, Jemison also had a school named after her in Detroit. (*AP*, Apr 4/93, Apr 19/93, May 24/93, May 26/93)

April 9: NASA announced that the Clementine mission to orbit the Moon and to visit an asteroid would be headed by Dr. Eugene Shoemaker of the U.S. Geological Survey, Flagstaff, Arizona. Clementine, sponsored by the Strategic Defense Initiative Office (SDIO), was scheduled to launch a small spacecraft in January 1994 to orbit the Moon for several months. The mission would test new, lightweight sensors in a space radiation environment and demonstrate autonomous navigation and spacecraft operation. (NASA Release 93-66)

- NASA said that two ozone monitors aboard the Space Shuttle Discovery were having difficulty sending measurements to ground controllers. Two monitors—one German and the other American—had trouble sending measurements to the ground. The U.S. monitor, which was supposed to supply most of the atmospheric research data, was also in danger of losing information. Timothy Miller, mission scientist for NASA, said a backup recorder for the U.S. ozone instrument could hold just over half the amount of data sought. NASA ground controllers were attempting to solve the problem. (*B Sun*, Apr 9/93; *NY Times*, Apr 9/93; *USA Today*, Apr 9/93; *W Post*, Apr 9/93; UPI, Apr 9/93; AP, Apr 9/93)
- Speaking at a news conference, NASA Administrator Daniel S. Goldin said that NASA intended to close an office in charge of planning American voyages to the Moon and Mars and to shift research to airplanes. The Agency was also dropping work on a huge new launch vehicle and turning to simpler, less expensive communications satellites. Goldin said the Agency was merely “taking a pause” in its pursuit of earlier space exploration goals. (*W Times*, Apr 9/93; AP, Apr 4/93; *C Trib*, Apr 11/93; *LA Times*, Apr 9/93)
- The White House provided more details on President Clinton’s plans to shift spending from defense to domestic “investment” priorities. The 1994 NASA budget request moved the agency away from big space flight projects involving humans toward development of new technologies with potential for practical use on the ground. The agency’s total budget would go to \$15.27 billion, an increase of almost \$1 billion. Most of the increase would be spent on aeronautics and other technologies, for example, development of a fleet of high speed planes for public transport and high speed computing. (*W Post*, Apr 9/93)

April 11: Space Shuttle Discovery astronauts released a spacecraft that was to study the solar wind and the Sun’s corona. The spacecraft would be picked up by Discovery after two days.

Using the Space Shuttle’s robot arm, astronauts Ellen Ochoa lifted the \$6 million SPARTAN satellite, which is about the size of a large air-conditioning unit, from its position in Discovery’s cargo bay and threw it into space.

SPARTAN carried two telescopes that would study the Sun’s halo: a white-light coronagraph to examine electrons and an ultraviolet spectrometer that would study protons and hydrogen atoms. The spacecraft was to investigate how the solar wind is generated in the Sun’s corona. The wind frequently disrupts navigation, communication, and electrical systems on Earth.

Another highlight of the Discovery mission occurred when Discovery astronaut Michael Foale chatted by ham radio with a crew member on the Russian Space Station Mir. The contact was the first ship-to-ship conversation in the Shuttle program.

Meanwhile, a data relay problem affecting one of the main ozone monitoring instruments on board Discovery was solved, and monitor readings were

successfully sent, although at a much slower rate. Flight Director John Muratore said such transmissions could free the recorder's tape and allow scientists to obtain all their required data. (AP, Apr 11/93; RTW, Apr 11/93; *NY Times*, Apr 12/93; *USA Today*, Apr 12/93; *W Times*, Apr 11/93; *P Inq*, Apr 11/93, Apr 12/93; *W Post*, Apr 12/93)

April 13: Scientists at NASA's Jet Propulsion Laboratory (JPL) and the California Institute of Technology announced that they had developed a computer software system to catalog and analyze the estimated half billion sky objects in the second Palomar Observatory sky survey. (NASA Release 93-067)

- NASA scientists reported that ozone-destroying forms of chlorine had existed for much longer in the Arctic stratosphere this winter than last. Northern Hemisphere ozone abundance also was observed to be some 10 percent below that measured during the same period last year, with some areas 20 percent lower. NASA's Upper Atmosphere Research Satellite (UARS) provided the information. (NASA Release 93-068; *NY Times*, Apr 15/93; AP, Apr 14/93)

- NASA reported that Space Shuttle Discovery's astronauts had retrieved the \$6 million satellite, called the SPARTAN, that they had released into space two days previously. When the Shuttle came to within 35 feet of the satellite, astronaut Ellen Ochoa grabbed it with the arm of the Space Shuttle's robot and placed it in its cradle in the Shuttle bay. The SPARTAN spent about 50 hours as a free-flying satellite with two automated telescopes gathering data about the Sun and the solar wind streaming from it. (AP, Apr 13/93; RT, Apr 13/93; *NY Times*, Apr 13/93; *W Times*, Apr 13/93, Apr 14/93; *W Post*, Apr 14/93; *B Sun*, Apr 14/93; *P Inq*, Apr 14/93; UPI, Apr 13/93; RT, Apr 13/93; *USA Today*, Apr 13/93, Apr 14/93, Apr 15/93; *C Trib*, Apr 15/93)

- Scientists at the Massachusetts Institute of Technology (MIT) reported that a powerful new x-ray camera had been shot into orbit just in time to focus on the newly discovered supernova. The scientists reported that the camera was providing very detailed information about the cosmic explosion. The MIT camera was one of several Japanese and American instruments put into orbit aboard a Japanese spacecraft launched on February 20. (*NY Times*, Apr 13/93)

- Martin Marietta Corporation reported that its Martin Marietta Astronautics Group had received a \$35 million contract from NASA's Jet Propulsion Laboratory to build the propulsion module subsystem for NASA's Cassini spacecraft mission that was to study Saturn, its Moon Titan, and the rest of the Saturnian system. The Cassini was scheduled for launch in October 1997. (*W Times*, Apr 13/93)

April 14: A leading astrophysicist, Dr. George F. Smoot of the Lawrence Berkeley Laboratory in California, reported in a lecture at the Carnegie

Institution of Washington that radio receivers in space and on the ground might be recording the passage of cosmic gravity waves, huge movements of space that echo the expansion of the universe 15 billion years ago. If he is correct, scientists would have a powerful new tool for studying the birth of the universe. (*NY Times*, Apr 14/93)

- The head of the Japanese space agency's office of space utilization said that Japan was unhappy with cutbacks to the Space Station Freedom project. Prime Minister Kiichi Miyazawa may bring up the issue at a meeting with President Clinton, scheduled to be held in Washington this week. (*LA Times*, Apr 14/93)

- Space Marketing Inc. of Rosell, Georgia, planned to launch the first space billboard in 1996. The orbital advertising sign was being produced in collaboration with engineers at Lawrence Livermore National Laboratory and the University of Colorado. The project triggered angry reactions from scientists and environmentalists. (*Antelope Valley Press*, Apr 14/93; *W Times*, Apr 15/93; *NY Times*, May 4/93)

April 15: NASA announced that NASA technology developed to keep astronauts cool on the lunar surface and a NASA patient-monitoring device, originally designed for astronaut heart rate transmittal, were scheduled to be inducted into the U.S. Space Foundation's Technology Hall of Fame on April 16. (NASA Release 93-069)

- The *Washington Post* reported the White House was seeking to quell expectation about U.S. and Russian cooperation on Space Station Freedom. In an April 13 letter to NASA Administrator Daniel S. Goldin, White House science advisor John H. Gibbons stated that the "White House has made no policy decision to focus our Space Station redesign effort around present or future Russian capabilities." He went on to say that "NASA should not limit its redesign options to those compatible with the orbit of the Russian Mir Space Station." (*W Post*, Apr 15/93; AP, Apr 15/93)

- According to a report in the *Baltimore Sun*, Space Shuttle Discovery lifted off with a pair of pliers stuck on a rocket booster. Officials said the pliers posed no danger during liftoff, but the incident was getting much attention in management circles. A Kennedy Space Center spokesperson said that the pliers were noted missing in a daily tool inventory at Discovery's launch pad on April 2 but that a proper lost-and-found report, which would have prompted a search, was not filed. NASA was also investigating how a foot-long metal scrap that could have set off an explosion became lodged in one of four launch-pad posts that held up one of Shuttle Discovery's rocket boosters. (*B Sun*, Apr 15/93; AP, Apr 15/93)

Writing in the *Los Angeles Times*, columnist Michael Schrage noted that "the Space Age is dead." An article in the *Washington Post* seemed to arrive at the

same conclusion. A space analyst noted that “the technologies no longer define our times, and the public has grown weary of multibillion-dollar celestial investments that yield minimal psychic or economic rewards.” Other commentators agreed that space as something special—as something that “embodies American values and self-image”—was dead. The emphasis was on programs that were fast, cheap, and cost-effective. (*LA Times*, Apr 15/93; *W Post*, Apr 19/93)

- The *Washington Post* reported that ozone layer problem appeared to be on the way to a solution. Thanks to the Montreal Protocol, an international treaty obligating signatory countries to phase out ozone-destroying chemicals, scientists expected the threat of ozone destruction to peak in 2000. In that year, according to the latest scientific projections, the ozone layer should start slowly getting thicker and better able to block the Sun’s harmful ultraviolet (UV) rays. (*W Post*, Apr 15/93)

April 16: In a speech to the National Space Symposium, NASA Administrator Daniel S. Goldin pledged to make the space program relevant to all Americans. He said he wanted everything smaller, faster, cheaper, and more varied. And he wanted to take more risks.

Commenting about the Space Station project, Goldin said that he wanted one that would cost half as much to develop and half as much to operate but would do more. He also urged the United States to enter into an international partnership with the Russians to put Space Station Freedom into orbit. (*Gazette Telegraph*, Apr 16/93; *Denver Post*, Apr 17/93)

- A fighter plane shaped like an arrowhead flew into NASA’s Langley Research Center this week. The plane, a heavily modified version of the Air Force F-16 fighter, has a wing that is narrow near the front of the plane and flares out near the tail. The plane was part of a program to build an efficient supersonic jetliner. (*Daily Press*, Apr 16/93)

April 17: The Shuttle Discovery landed at the Kennedy Space Center after a day’s delay caused by stormy weather. Brewster Shaw, Deputy Space Shuttle Program Manager, pronounced the mission “very successful.” The landing cleared the way for launch preparations for Shuttle Columbia’s second launch attempt, scheduled for April 14, just seven days after the Discovery landing. This was shortest time between manned missions in the history of American space travel. Columbia’s first launch attempt was aborted by an engine shutdown on March 22. Columbia was to carry scientific experiments sponsored by Germany. (*RTW*, Apr 17/93; *AP*, April 17/93; *UPI*, Apr 4/17; *W Post*, Apr 18/93; *NY Times*, Apr 18/93; *P Inq*, Apr 18/93; *USA Today*, Apr 18/93; *Reuters*, Apr 22/93)

- Brian Marsden, director of the Central Bureau for Astronomical Telegrams, an agency in Massachusetts that reports on discoveries in astronomy, announced that a big comet had broken into at least 20 chunks that were now orbiting

Jupiter. Astronomers said the situation was reminiscent of the catastrophe that occurred 65 million years ago when the Earth was bombarded with debris from a heavenly body. It was that bombardment, they maintain, that destroyed the dinosaurs and many other species. Calculations show that the original comet probably broke up under the force of Jupiter's gravity last May when it apparently was within 659,000 miles of the planet. (*NY Times*, Apr 17/93, June 1/93)

April 18: Writing in the *New York Times*, Robert L. Park, professor of physics at the University of Maryland, suggested that now that the cold war was over and there was no longer any need to demonstrate U.S. space superiority over the Soviet Union, the time had come to "put Space Station Freedom out of its misery." Parks noted that there was very little one could do in a Space Station; he added that the scientific accomplishments of the Russian cosmonauts in Russian Space Station Mir had been meager and that there was little expectation that U.S. astronauts would do any better. He noted, further, that the costs connected with the station were enormous. (*NY Times*, Apr 18/93)

April 19: The new Keck Telescope in Hawaii, the world's largest optical and infrared telescope, revealed unprecedented detail in an image of the farthest known galaxy in the universe. The image showed a galaxy in the constellation Lynx, near the Big Dipper, that was thought to be 12 billion light-years away. (*W Post*, Apr 19/93; *B Sun*, Apr 18/93)

- The *New York Times* reported that a dispute had broken out in the Clinton administration over Vice President Al Gore's attempts to convince President Clinton to fulfill a campaign pledge to reduce the threat of global warming. Gore urged the President to commit the United States to freezing at 1990 levels the amount of global-warming pollution stemming from cars, trucks, and factories; the standard would be reached by 2000. Other administration officials, principally Treasury Secretary Lloyd Bentsen and Energy Secretary Hazel R. O'Leary, contended that the administration had not adequately studied how such a mandate would affect American industry. (*NY Times*, Apr 19/93)

- Russian officials announced that two Russian cosmonauts had taken a space walk to rearrange solar panels on the outside of the Mir Space Station in order to increase the panels' efficiency. The rearrangement also would prepare the Mir for an eventual docking by the U.S. Space Shuttle. The cosmonauts encountered several problems during the walk and had to stay outside their capsule longer than planned. (*AP*, Apr 4/19, Apr 4/20; *RTW*, Apr 20/93; *USA Today*, Apr 20/93)

- NASA Administrator Daniel S. Goldin announced the appointment of Jeff Lawrence, a senior congressional staff aide with experience in space and aeronautics matters, as the agency's Associate Administrator for Legislative Affairs. (NASA Release 93-70; *W Post*, Apr 21/93)

April 21: According to news reports, Russia was scheduled to launch an Israeli-made communications satellite in 1995. This was the first such agreement between the two countries. (AP, Apr 21/93)

- Russian experts were expected to arrive in Washington this week to act as consultants to the U.S. Space Station redesign team. NASA selected the East-West Space Science Center at the University of Maryland to coordinate the effort under the direction of Dr. Roald Sagdeev. Arnold Aldrich, NASA Associate Administrator for Space Systems Development, noted that an ambitious joint spaceflight program already was in process. Two Russian cosmonauts were training at the Johnson Space Center in Houston, for example, and early next year two American astronauts would go to Russia for training. (CSM, Apr 21/93; *B Sun*, Apr 21/93)

- NASA announced that Shuttle Columbia, with a science mission paid for and directed by Germany, was scheduled to be launched on April 24. The launch was scheduled to take place just seven days after Discovery's return from an atmospheric research flight. An engine shutdown March 22 halted Columbia's launch with just three seconds to go. (AP, 4/21; 93; RTW, Apr 4/93; UPI, Apr 21/93; *USA Today*, Apr 22/93; *W Post*, Apr 22/93)

April 22: Measurements taken recently in Barrow, Alaska, one of several ozone monitoring stations, revealed the first signs of ozone depletion over North America. The depletion, however, was far less severe than that found over Antarctica. (*USA Today*, Apr 22/93)

- Fourteen scientists, most of them from NASA's Goddard Space Flight Center in Greenbelt, Maryland, and the National Oceanic and Atmospheric Administration (NOAA), said that world ozone had dropped to its lowest levels since scientists began monitoring the protective layer. The drop might be a delayed effect of the eruption of Mount Pinatubo in 1991. The scientists emphasized that the findings did not mean that the Northern Hemisphere was experiencing an "ozone hole" like the one that forms over the South pole, and that the ozone hole did not pose a significant health threat. The new findings were based on observations by several Earth-orbiting satellites operated by NASA and NOAA and confirmed by ground-based ozone monitoring instruments. (NASA Release 93-74; AP, Apr 22/93, Apr 23/93; *USA Today*, Apr 23/93; *W Post*, Apr 23/93; *B Sun*, Apr 23/93; *WSJ*, Apr 23/93; *NY Times*, Apr 23/93)

- NASA announced that an American satellite had detected the most intense flash of gamma radiation observed in the two years of its operation. The burst, known as "the super bowl" event because it occurred on the day of this year's national championship game, appeared to produce 10 times more energy than any previously observed gamma-ray burst. The burst also led scientists to say that the bursts were not the product of merely hot "cooking objects," but of particles being accelerated to near the speed of light and being

emitted in focused beams, or jets. The new findings suggested that the bursts originated far beyond the Milky Way Galaxy. (NASA Release 93-72; Reuters, Apr 22/93; *W Post*, Apr 23/93; *NY Times*, Apr 23/93; *B Sun*, Apr 23/93; APN, Apr 4/23)

- NASA announced that a NASA F-15 research aircraft made a touchdown on April 21, using only engine power for control. The plane landed at NASA's Ames-Dryden Flight Research Facility, Edwards, California. The flight was part of NASA's attempt to develop a computer-assisted engine control system that lets a plane land safely with only engine power if its normal control surfaces are disabled. (NASA Release 93-75)

- NASA Administrator Daniel S. Goldin announced that Bryan O'Connor, Deputy Director of the Space Station redesign team, would take over management of the Space Station effort in order to accommodate a request by the team's leader, Joseph F. Shea, that his workload be reduced. Shea submitted his resignation as Assistant Deputy Administrator for Space Station analysis; he was to serve as Special Advisor to the Administrator and advisor to O'Connor. (NASA Statement on Advisory Committee Meeting)

April 23: NASA announced that the December flight of the Endeavour Space Shuttle mission to service the Hubble Space Telescope was scheduled to last 11 days and to involve a record of five spacewalks, with the possibility of two additional walks, if needed. (NASA Release 93-76; *W Times*, Apr 25/93)

- Richard T. Barrett, a senior design engineer at NASA's Lewis Research Center, Cleveland, Ohio, was awarded the Federal Laboratory Consortium Award of Excellence in Technology Transfer for 1993. (NASA Release 93-73)

April 24: NASA canceled the Space Shuttle Columbia launch, scheduled for April 24, because of problems with a key navigational aid. The launch was rescheduled for 10:50 a.m. April 26. (UPI, Apr 24/93; RTW, Apr 24/93; *P Inq*, Apr 25/93; *NY Times*, Apr 25/93; *B Sun*, Apr 24/93)

- U.S. Senate candidate Richard Fisher called Space Station Freedom a "pork barrel" project in a speech on Friday. Fisher, a Texas investor, was running as a Democrat in a special May 1 election. Fisher had advised the independent presidential campaign of Ross Perot, who had criticized the lack of spending controls on the Space Station project. Fisher, who in the past had voiced support for the Superconducting Super Collider, said that he was still studying the project's worth. (*H Chron*, Apr 24/93)

April 25: NASA officials announced on April 25 that a three-month review of the development of Space Station Freedom's Work Package 1 had been successfully completed. The work package involved work on laboratory and critical subsystems. The Marshall Space Flight Center and its main contractor

Boeing Defense & Space Group were responsible for the work, which included many elements considered the core of the Space Station. (UPI, Apr 25/93)

- Space Shuttle Columbia was fueled for the third launch attempt of a science mission chartered by Germany. The mission, which was years behind schedule, was scheduled for launch Monday, April 26 at 10:52 a.m. (UPI, Apr 25/93; AP, Apr 26/93; NY Times, Apr 26/93; USA Today, Apr 26/93; RTw, Apr 26/93)
- The *Washington Post* reported that NASA, under White House instructions to cut the budget of Space Station Freedom, was attempting to push the McDonnell Douglas Corporation out of the \$30 billion Space Station contract. McDonnell Douglas was the prime contractor in the project, which had cost overruns of between \$300 million and \$1 billion. (*W Post*, Apr 25/93)
- In a letter to the editor of the *Washington Post*, Michael Oppenheimer, senior scientist at the Environmental Defense Fund in New York, took issue with an April 5 *Washington Post* article on ozone depletion. Oppenheimer charged that the article failed to "convey the seriousness of the ozone depletion problem." (*W Post*, Apr 25/93)
- The *Los Angeles Times* reported that NASA was using a new x-ray machine, called the Reverse Geometry x-ray system, to examine parts of the Space Shuttle. The new technology, produced by the Digiray Corporation, eliminates fuzzy images and displays a 3-D picture almost instantly. (*LA Times*, Apr 25/93; AP, May 24/93)

April 26: Space Shuttle Columbia was launched on Monday, April 26, on a German science mission that had been delayed for over two months. This was the third attempt at launching the Columbia mission. By launching the mission only nine days after the return of Shuttle Discovery, NASA broke the record for the shortest interval between U.S. human space flights.

The flight was dedicated to German scientific research, including studies of how the human body reacts to the reduced gravity in space. The mission featured 88 experiments in materials, science, medicine, biology, astronomy, Earth observation, and robotics. (UPI, Apr 26/93; RTW, Apr 26/93; AP, Apr 27/93; *P Inq*, Apr 27/93; *B Sun*, Apr 27/93; *USA Today*, Apr 27/93; *W Post*, Apr 27/93; *NY Times*, Apr 27/93; *W Times*, Apr 27/93)

April 27: The *New York Times* reported that 1993 had become the year of the supernova for astronomers and astrophysicists. The appearance on March 28 of a rare and very bright supernova named SNI993J led to a great deal of information. Researchers also made many discoveries about supernova by conducting laboratory experiments and by using powerful supercomputers to test competing theories. The former investigations were conducted by research teams

at the TRIUMF National Laboratory in Vancouver, British Columbia, and Yale University. The Lawrence Livermore National Laboratory in California used its supercomputers to pick out the theory that appeared best to explain what astronomers see when a supernova explodes. (*NY Times*, Apr 27/93)

- The journal *Science* reported that the brightness of a full Moon, thought to be caused by a process called shadow hiding, in which the Sun shining directly on the Moon minimizes shadows, is really caused by a phenomenon known as coherent backscatter.

Coherent backscatter involves "reflection of light rays from the surface of the Moon, which combine with light from the Sun to create a brighter lunar appearance as seen from Earth," according to Robert M. Nelson, an astronomer at the Jet Propulsion Laboratory in Pasadena, California, and the author of the new study. (*NY Times*, Apr 27/93)

- Astronauts aboard Shuttle Columbia left their medical and scientific studies on Tuesday, April 27, to work on repairing a malfunctioning toilet and waste-water system. Engineers believed that a device that squirts waste overboard from a storage tank got stuck and caused the tank to spring a small nitrogen leak. The astronauts rerouted the waste into two rubber-lined storage bags until the problem could be fixed. NASA said that the problem would not endanger the nine-day mission. Earlier in the day, the astronauts carried out a series of medical and scientific experiments. (UPI, Apr 27/93; AP, Apr 28/93; RTW, Apr 27/93, Apr 28/93; *NY Times*, Apr 28/93; *C Trib*, Apr 28/93)

April 27: Reinhard Furrer, a former German astronaut, criticized the German government for planning to cut funds for manned space flights such as the U.S.-German Shuttle mission now orbiting the Earth. Furrer flew on a joint U.S.-German scientific mission in 1985. (RTW, Apr 27/93)

- During Take Our Daughters to Work Day on April 26, daughters of Johnson Space Center employees got to see where astronauts prepare for space flights and were even able to test the pressurized space suit gloves worn by astronauts. Daughters were also welcomed at NASA's Dryden Flight Research Facility, where they toured the control room, investigated an SE-71 cockpit, and crawled around inside a modified Boeing 747. (AP, Apr 27/93; *W Times*, Apr 29/93; *Antelope Valley*, Apr 29/93)

April 28: An article in the *Christian Science Monitor* reported that scarce NASA funding jeopardized the Space Station and manned flights. NASA had asked for a \$1 billion increase over fiscal year 1993; however, Representative Ralph Hall, D of Texas, the chairman of the House space subcommittee, told Daniel S. Goldin, NASA Administrator, that a billion-dollar increase was not very likely. (CSM, Apr 28/93)

- NASA announced that Marta Bohn-Meyer, an aeronautical engineer at NASA's Dryden Flight Research Facility, was one of 10 Federal government employees chosen to receive the 1992 Arthur S. Flemming Award. The reward "recognizes U.S. government employees for outstanding and meritorious work," according to NASA. (*Antelope Valley Press*, Apr 28/93)

April 29: The media reported that the crew aboard Shuttle Columbia had succeeded in flushing urine and other waste water into space from a backup storage system. This was the first time crew members had attempted to dump fluid overboard from contingency containers. Later in the day, the astronauts repaired a nitrogen gas line, restoring the shuttle's normal water pressure, which had dropped as a result of the Shuttle's plumbing problems. The mission's science experiments continued as planned.

Late Wednesday, April 28, German astronaut Hans Schlegel turned on a 2 1/2-foot-long robot arm and got it to move as planned after adjusting a joint that NASA scientists said might have been bumped out of place during launch. Later, NASA ground controllers maneuvered the robot to demonstrate how robots perform in microgravity. (*W Post*, Apr 29/93; *B Sun*, Apr 29/93; *USA Today*, Apr 29/93; *P Inq*, Apr 29/93; *RTw*, Apr 29/93; *AP*, Apr 29/93; *UPI*, Apr 29/93)

- NASA announced that the National Technology Transfer Center (NTTC), Wheeling, West Virginia, had entered into an agreement with the Strategic Defense Initiative Organization (SDIO) to assist SDIO in the operation of its Technology Applications Information System and to help identify items that should be included in the technology applications database. (NASA Release 93-77)

April 30: The *Wall Street Journal* reported that a cable-television venture by NASA was becoming very popular among space buffs nationwide. Called NASA Select, the channel provides a variety of coverage, ranging from routine news briefings on space issues to reports on the current Columbia space mission. Viewers said that they were especially excited by the spectacular vistas beamed down from space. The channel airs as a public service on local cable-TV systems Monday through Friday from noon until 4 a.m. (*WSJ*, Apr 30/93; *C Trib*, May 2/93)

- The media reported that Columbia's astronauts were attempting to find a slight air leak that NASA said posed no danger to the crew. The leak had been detected the previous evening. According to NASA sources, the leak would not affect the duration of the space mission. (*AP*, Apr 30/93)

- Writing in the *Washington Post*, columnist Michael Schrage reported that physicist John H. Gibbons, White House science and technology policy advisor, was facing some tough choices. He soon had to decide whether science

and technology would play a leadership role in the Clinton administration's economic agenda or merely a supporting one. That choice appeared to be as yet unmade. (*W Post*, Apr 30/93)

May

May 2: NASA rewarded the Columbia astronaut's energy-conservation efforts by adding a day to the Space Shuttle's mission. The extra day would allow scientists to meet and possibly exceed mission goals, which had been jeopardized by equipment problems.

German researchers announced that their robot arm had successfully grabbed a free-floating object in space under remote control from Earth. They also reported that some of the larval fish and tadpoles aboard the Shuttle were dying.

Among other experiments undertaken on the last days of the flight was the injection of two German astronauts with nearly a half-gallon of saline solution each in an experiment intended to test how to fight dehydration in space. (AP, May 2/93, May 3/93, May 4/94; RTW, May 3/93, May 4/93; UPI, May 3/93; W Post, May 2/93, May 3/93; W Times, May 1/93; B Sun, May 2/93, May 3/94; USA Today, May 3/93; NY Times, May 2/93, May 3/93)

May 3: William F. Ballhaus Jr. was named president of the Martin Marietta Corporation's Aero & Naval Systems division in Maryland. Ballhaus was Director of NASA's Ames Research Center for a number of years. (B Sun, May 3/93)

- NASA announced that the Mars Observer spacecraft had returned to normal operations after its main antenna failed to point at Earth for the third time in about four months. Engineers were fairly certain that the glitch had been caused by a computer-programming problem. (AP, May 3/93; W Times, May 4/93)

May 4: The *Houston Post* reported that the two committees charged with redesigning Space Station Freedom were behind schedule. The two groups, a technical redesign team mainly made up of NASA employees and a team of outside experts, had been faced with much infighting at NASA and a barrage of criticism from Congress and the foreign countries participating in the Space Station project. NASA Administrator Daniel S. Goldin asserted that the work would be finished on time. (H Post, May 4/93; AvWk, May 3/93; H Chronicle, May 6/93)

- The *Washington Times* reported that a group of five investors, headed by retired Navy Admiral Thomas H. Moorer, had signed a joint venture agreement with Russia's Association for the Conversion of Submarine-Launched Ballistic Missiles. The group planned to use Russian missiles to put satellites into low orbits to transmit telephone calls or computer data or carry out scientific experiments. (W Times, May 4/93)

- NASA reported that it had lost all contact with Shuttle Columbia for 80 minutes on May 4 because of an erroneous computer command sent to the

Shuttle. The blackout led to the loss of some science data but did not cause any major problems; NASA officials, however, reviewed procedures for creating and sending commands to the Shuttle antenna.

During a briefing for Mayo clinic physicians, Bernard Harris Jr., a doctor-astronaut aboard Columbia, said that the human heart shifts inside the body in zero gravity. Space travel also leads to swollen faces, engorged eye blood vessels, and space motion sickness, said Harris. (UPI, May 4/93; RTW, May 4/93; *W Times*, May 5/93; *USA Today*, May 5/93; *B Sun*, May 5/93; *NY Times*, May 5/93)

May 5: Astronauts aboard Space Shuttle Columbia prepared for a May 6 landing at Kennedy Space Center in Florida. The Shuttle was scheduled to land at 9:03 a.m., ten days after launch.

Columbia's astronauts flexed a life-size robot one last time in space and completed as many laboratory experiments as possible before getting ready to return home. (UPI, May 5/93; RTW, May 5/93; *N Times*, May 6/93; *W Post*, May 6/93; *USA Today*, May 6/93; *P Inq*, May 6/93; *B Sun*, May 6/93)

- The *Prince William Journal* reported that Daniel Goldin, NASA Administrator, had decided that NASA should spend \$90 million for the development of the Perseus aircraft, a remote-controlled drone that NASA had contracted with Aurora Flight Science Corporation of Manassas to build. The unmanned aircraft would be used for environmental studies of the upper atmosphere. (*Prince William Journal*, May 5/93; *LA Times*, May 9/93; UPI, May 14/93)

May 6: The *Wall Street Journal* reported that technical problems had delayed until August the launch of the unmanned Comet space rocket on which Columbia Pictures had a giant outer-space billboard advertising its major summer movie, "Last Action Hero." (*WSJ*, May 6/93; *W Times*, May 7/93; *NY Times*, May 11/93)

- The media reported that House of Representative lawmakers had charged that NASA and the Department of Defense were dragging their feet in getting a hypersonic airplane, the National AeroSpace Plane (NASP), out of the design stage. House members complained that the \$2 billion invested so far in the NASP had not brought the project any closer to fruition. Experts maintained that the NASP would be the fastest aircraft in the world and would revolutionize space travel as well as make the Nation more economically competitive. (*Antelope Valley Press*, May 6/93; *Washington Technology*, May 20/93)

- According to the *Wall Street Journal*, five aerospace companies were proposing to revive planning for an advanced new rocket to carry satellites and other commercial payloads into space. The companies had asked NASA to join in planning and researching the project; they anticipated that it would help the U.S. gain a greater share of the commercial launch business now dominated by Arianspace, a European joint venture. (*WSJ*, May 6/93)

May 7: The *W Times* reported that a joint U.S.-German experimental fighter jet had completed a revolutionary rapid turn in flight. The aircraft slowed from a speed of about 300 miles an hour and reversed direction in only nine seconds using a tight, looping turn. According to the Pentagon, the turn was far beyond the aerodynamic capability of any conventional fixed-wing aircraft. The test flight took place at Edwards Air Force Base, California.

(*W Times*, May 7/93)

- The European Space Agency (ESA) announced that it had picked two Germans, a Spaniard, and a Swede for its first joint missions with Russian astronauts to the Mir-1 Space Station in 1994 and 1995. The ESA had reserved one slot each for the two flights. A decision on which two men would participate would be made in the weeks before the flight. (RTw, May 7/93)

- At a news conference during the annual Naval Aviation Symposium, astronauts Eugene Cernan, Alan Shepard, Neil Armstrong, and James Lovell spoke of the importance of continued exploration of the Moon. Cernan, the last man to walk on the Moon, said, "We are going to go. It's man's intuitive spirit to go back and go on to Mars." (AP, May 7/93)

- The media reported that the Space Shuttle Columbia landed May 6 at Edwards Air Force Base, California, after low clouds at Cape Canaveral, Florida, forced it to divert to California.

NASA called the Columbia's return "a significant milestone" because shuttles have now spent a total of more than a year in orbit since the first one was launched in 1981. However, John Pike, a space analyst for the Federation of American Scientists, said he wondered if the Shuttle flight was worth what it cost. There are "good reasons for flying in space, but science isn't one of them," Mr. Pike said. (APn, May 5/93; *USA Today*, May 7/93; *W Times*, May 7/93; *N Sun*, May 7/93; *LA Times*, May 7/93; *NY Times*, May 7/93; *W Post*, May 7/93)

May 9: The *New York Times* reported that astronomers were worried about growing light pollution, which makes it very difficult for even the strong 200-inch telescope on Mount Palomar in California to pick up faint galaxies. Some cities, hoping that brighter lighting would deter crime, were installing white street lights as opposed to low-pressure sodium lamps, which are easily filtered from telescopes. In addition, a Georgia company announced plans to put a one-mile reflective panel into space some time in 1996; the satellite, which would appear nearly as large as the Moon, would add to the light pollution. (*NY Times*, May 9/93)

May 10: The *Washington Post* reported that NASA had selected three design concepts from among the many that had been proposed since the White House told the Agency to come up with a new, half-price plan by early June. White House guidelines called for NASA to design a long-duration laboratory in orbit

that would use the weightlessness of space as a tool for research on materials and living things, as a means of developing technology and engineering skills for advanced human and robotic space systems, and as a way to encourage international cooperation. (*W Post*, May 10/93)

- The *Houston Chronicle* announced that NASA, responding to criticism of its cost overruns and the quality of its projects, had announced major reforms in the way it did business. In addition to other changes, procurement reforms would levy greater penalties on contractors that deliver defective products, continually exceed cost estimates, or fall behind schedule. (*H Chron*, May 10/93; *Federal Computer Week*, May 24/93)

- In an address to the American Institute of Aeronautics and Astronautics (AIAA), Daniel S. Goldin, NASA Administrator, said that the redesign effort for Space Station Freedom was making "great progress." (*AvWk*, May 10/93)

- Gregory M. Reck, NASA's Acting Associate Administrator for Advanced Concepts and Technology, announced that the first flight of Comet, the Commercial Experiment Transporter, would slip from mid-June to at least July or August. The launch had already been delayed for two months because of technical difficulties. (*AvWk*, May 10/93)

May 11: NASA announced that the Agency would design and install an acoustic lining in the wind tunnel at NASA's Ames Research Center, Mountain View, California. The improved wind tunnel ultimately would help U.S. industry design quiet engines for a future high-speed civil transport and for new helicopters. (NASA Release 93-81; *San Francisco Examiner*, May 9/93)

- NASA announced that it and the National Center for Manufacturing Sciences (NCMS) had signed an agreement that would allow the two organizations to propose joint research projects. The NCMS is a non-profit research consortium created by U.S. industries to conduct, sponsor, fund, and otherwise promote development of technologies or scientific applications that would improve manufacturing in the United States and Canada. (NASA Release 93-82)

- The *LA Times* announced that Russian space officials had signed a contract in late April for the first commercial launch of a Western-built satellite by a Russian rocket. The agreement was signed with Inmarsat, a 67-country consortium that puts up satellites for mobile communications. (*LA Times*, May 11/93)

- The *NY Times* reported that after examining the problem for more than a year, a supercomputer had concluded that the Theory of Quantum

Chromodynamics was probably correct. The theory accounts for the relationships between fundamental particles called hadrons. (*NY Times*, May 11/93)

- European space officials in Paris announced that Western Europe's Ariane rocket had deployed a U.S.-built television satellite on Wednesday after a launch from French Guyana. (RTW, May 11/93)

May 12: *USA Today* reported that scientists on the Space Shuttle Columbia during its fall mission were scheduled to behead five white rats. Space program scientists Frank Sulzman said that killing the rats in orbit would give researchers better information on the effect of weightlessness on the animals. (*USA Today*, May 12/93)

- The *Christian Science Monitor* reported that astronomers who study the evolution of the cosmos hoped that the Hubble Space Telescope, if it could be repaired as planned this December, would help them resolve a paradox relating to the universe's age. Current research implies that the universe is younger than the oldest stars. One of the Hubble's key missions was to refine what had become the foundation for many cosmic distance scales. (CSM, May 12/93)

May 13: The media reported that a 23-year-old computer hacker had penetrated the top-secret computer files of NASA, forcing the closure of the system for 24 hours. The hacker, Richard Martin Jones, also helped another computer buff enter the NASA files. (UPI, May 13/93; RTw, May 13/93)

May 14: NASA announced that scientists at its Ames Research Center, Moffett Field, California, would use a satellite video link to attempt to maneuver a Russian robotic "rover" in a Moscow laboratory. (NASA Release 93-84)

- The Associated Press announced that NASA engineers had searched for the source of a mysterious "bang" in Shuttle Endeavour's engine compartment. The sound was heard as the Shuttle was being prepared for a June 3 launch. (AP, May 14/93)
- NASA announced the solicitation of proposals for the Technology Reinvestment Project, a \$471 million Federal interagency effort to develop and deploy dual-use technologies and at the same time give a competitive advantage to American companies. (NASA Release 93-85)
- The media reported that NASA administrators were seeking to quell the concerns of European space officials over the redesign of the planned U.S. Space Station. Clinton's decision to redesign the project could have "disastrous effects" if it results in an orbiting lab unsuitable to foreign partners, a German executive said. (WSJ, May 14/93; AP, May 13/93)

- Defense Secretary Les Aspin announced that the Clinton administration would continue work on anti-missile weapons but that Reagan's "Star Wars" program was being reduced to small-scale research and renamed the Ballistic Missile Defense Organization. In California alone, the cutback threatened more than \$1 billion in annual contracts and thousands of jobs, according to economists in the area. (*NY Times*, May 14/93; *LA Times*, May 14/93)

- President Clinton named David R. Hinson, an aerospace executive and former Navy fighter pilot, to head the Federal Aviation Administration. Mr. Hinson was founder of Midway Airlines. In his new job, Hinson would oversee the safety of the aviation industry and be responsible for initiating and enforcing safety regulations and operating the air traffic control system. (*NY Times*, May 14/93; *USA Today*, May 14/93)

May 17: NASA announced that researchers at NASA's Lewis Research Center, Cleveland, Ohio, had developed an ion exchange material that in laboratory tests effectively removed contaminants from water. Tests showed that the new material was easy to use and inexpensive to produce. (NASA Release 93-86)

- The media reported that NASA and the astronomical community had differing views on an orbiting billboard that would beam a Moon-sized message back to Earth. NASA spokesman Charles Redmond said that the "space billboard" was in line with the Space Agency's aims, that is, to encourage commercial development of space. A quite different view was expressed by Carl Sagan, a well-known U.S. astronomer and university professor, who called the project an "abomination" and said that it was "the thin edge of a wedge which may destroy optical ground-based astronomy..." An American Astronomical Society spokesman said the billboard would hamper Earth-based astronomy, add to the growing pollution of the night sky by light, and even infringe on everyone's enjoyment of nature's sunsets." (RTW, May 17/93)

- NASA announced the formation of an International Mars Exploration Working Group. In addition to NASA, members included the European Space Agency, the Russian Space Research Institute, the Italian Space Agency, the German Space Agency, and the French Centre National d'Etudes Spatiales. The group would focus on producing an international strategy for the exploration of Mars after the year 2000. (NASA Release 93-87)

- NASA announced that it had joined with American Bio-Technologies Inc. of Cambridge, Massachusetts, in an attempt to arrive at a better understanding of Acquired Immune Deficiency Syndrome (AIDS). The goal was to use advanced x-ray technology and expertise developed by NASA's Marshall Space Flight Center, in Huntsville, Alabama, to advance knowledge of Human Immunodeficiency Virus (HIV) and AIDS, to develop new therapeu-

tic approaches for HIV and AIDS, and to develop superior biological materials for vaccine development and HIV detection. (NASA Release 93-88)

- The Associated Press reported that the Everglades-style airboat used to maintain navigation lights at the Space Shuttle's California landing site had been named "Puddle shuttle," after a contest among workers. (AP, May 17/93)
- The *Washington Post* reported that NASA's dream of building a permanent human outpost in space was generating much controversy. President Clinton's decision to shrink Space Station funding and his mandate that the station be redesigned added to the controversy. (*W Post*, May 17/93)

May 18: NASA announced that the Magellan spacecraft would dip into the atmosphere of Venus beginning May 25 in an "aerobraking" maneuver that would slow the spacecraft and allow it to circularize Magellan's orbit. Currently Magellan was looping around Venus in a highly elliptical orbit. The new orbit would make possible better measurements of Venus' gravity fields. (NASA Release 93-89)

- A *Christian Science Monitor* editorial urged the Clinton administration to rethink its civilian space program, noting that the program had drifted without overall purpose since rivalry with the old Soviet Union had ceased to be a significant factor. The editorial urged the administration to define what the United States should accomplish in space and outline a realistic program to do it. (CSM, May 18/93)
- The *Washington Times* reported that the former Soviet military had welcomed the U.S. decision to scrap most of the Strategic Defense Initiative. Russian Defense Minister Pavel Grachev called the decision a "reasonable decision" and said that "it seems there's no reason to raise the possibility again" of putting weapons in space. (*W Times*, May 18/93)
- The *Baltimore Sun* reported that researchers believed that a meteorite that crashed through a Japanese home in December probably was a piece of the same space object as a falling star that landed in Japan more than a thousand years ago. (*B Sun*, May 18/93)
- A NASA spokesman announced that the Mars observer spacecraft had spent eight days pointing the wrong direction but engineers thought that they now had the problem under control. It was the Observer's fourth such malfunction. Mars Observer was scheduled to go into elliptical orbit around Mars on August 24. (AP, May 18/93)
- Robert T. Dulaney, a salesman who sold foreign-made fasteners to a NASA contractor in violation of a Federal law that required that all fasteners purchased by NASA be domestic in origin, was sentenced to five years probation,

including 60 days home confinement. Dulaney was also ordered to repay \$26,567.73 to NASA. (UPI, May 18/93)

- NASA engineers believed that they had identified the source of a mysterious “bang” in Shuttle Endeavour’s engine section. A Kennedy Space Center spokesman said that probably a ball inside a flexible joint on a fuel line had gotten pinched. (AP, May 18/93)

- U.S. and European space officials announced that they had postponed a planned rocket firing intended to move the European Retrieval Carrier (EURECA) to a position where it could be retrieved by a Space Shuttle next month. An apparent gyroscope problem aboard the orbiting research satellite forced the postponement. (RTW, May 18/93)

- An article in *Flight International* featured the U.S. Spacehab, the world’s first privately owned, manned microgravity laboratory. The Spacehab was scheduled to be lifted aboard the Space Shuttle Endeavour mission on June 3.

The Spacehab was funded partly by a \$185 million contract from NASA that enabled the Agency to use two-thirds of the Spacehab’s capacity during the first six flights. The Spacehab, however, would need the commitment of commercial customers in order to survive, according to the author of the article. (*Flight International*, May 18/93)

May 19: NASA reported that the agency was working with the Nation’s large aerospace companies to determine how NASA computer programs could help industry design and produce aircraft more efficiently. The ultimate goal was to integrate all the factors involved in aircraft design and production so that aeronautical engineers would be able to design aircraft systems simultaneously rather than separately as is done now. (NASA Release 93-90)

- NASA announced a new initiative to commercialize NASA inventions by using top graduate students at Case Western to come up with new product ideas and strategies. NASA’s Lewis Research Center, the Battelle Memorial Institute, and Case Western Reserve University, all based in Cleveland, Ohio, were involved in the program. (NASA Release 93-91)

- The media reported that a Naval panel inquiry into the crash of the V-22 experimental aircraft, nicknamed the Osprey, in the summer of 1992 had found evidence that an improperly installed seal may have permitted gearbox oil to leak, possibly contributing to the crash. The panel also noted that the pilot, under strong pressure to arrive on time for a ceremony at Quantico Marine Base, had skipped a scheduled refueling stop and ignored a warning that might have forced him to ground the plane for a maintenance check. The Navy authorized resumption of flight testing of the Osprey after release of the final report. (*W Post*, May 19/93; *P Inq*, May 19/93; *USA Today*, May 19/93)

- The *Washington Times* reported that the journal *Science* had added its voice to those who maintained that the ozone-depletion threat had been overestimated. In an earlier article, the *Washington Post*, which in the past had editorialized strongly for worldwide controls on ozone-depleting substances, also concluded that many scientists, including some in the environmental movement, agreed that the ozone threat had been overestimated. Not all experts agreed with the position taken by the authors of the articles in *Science* and the *Post*, however. (*W Times*, May 19/93)

May 20: NASA announced that a 50-monitor videowall would be featured at the NASA exhibit at the 40th Paris Air Show, Le Bourget, France, June 10-20. The video presentation featured interviews with Carl Sagan, James Michener, and Roald Sagdeev, among others. (NASA Release 93-92)

- *Washington Technology* reported that at a May 11 appearance before the annual meeting of the National Center for Manufacturing Sciences (NCMS), NASA Administrator Daniel S. Goldin emphasized his commitment to NASA's technology-transfer outreach to industry. At the meeting, Goldin announced a memorandum of understanding that allowed NASA and the NCMS to propose joint research projects. (*Washington Technology*, May 20, 1993)

- NASA announced that scientists at the Ames Research Center, Moffett Field, California, were measuring how the human body reacted to exercise done on Earth and comparing those measurements to the exercise measurements of astronauts working in the microgravity environment of space. The goal was to try to improve the productivity of astronauts involved in space walks. (NASA Release 93-93)

May 21: NASA announced that June 3, 1993 had been set as the target date for the STS-57 mission of Space Shuttle Endeavour. The mission would be highlighted by the retrieval of the European observation satellite EURECA and the first flight of Spacehab, a commercial spacelab facility. (NASA Editors Note N93-28)

- In his keynote address at the inaugural University of Southern California Engineering Day, Daniel S. Goldin, NASA Administrator, emphasized that space exploration involved risks but that they were worth taking. He also said that NASA's specific challenge was to "win back our credibility through performance." (*LA Times*, May 21/93)

- The media reported that Representative George E. Brown, chairman of the House Science, Space, and Technology Committee, told a news conference that NASA's effort to save Space Station Freedom was doomed unless the project continued with a scaled-down version of the current design. Although the streamlined model of Freedom was the most expensive of the three

options being analyzed, Brown noted that it was also the one with years of experience and \$8 billion in development costs behind it. (WP, May 21/93; H Chron, May 21/93; LA Times, May 21/93; W Times, May 21/93; NY Times, May 21/93; W Post, May 21/93; AvWk, May 24/93)

- Writing in the *Philadelphia Inquirer*, Daniel S. Greenberg noted that “times are bad” for the so-called mega projects of our era: Star Wars, the Space Station, and the super atom smasher in Texas. He warned, however, that big-science mobilization should not automatically be suspect, suggesting, for example, that the country would benefit from an all-out effort on a project such as the electric car. (*P Inq*, May 21/93)

May 23: The *Washington Times* reported that the launch of a rocket with a “star wars” payload had been scrubbed on May 22, just a minute before its scheduled launch. The Air Force blamed the failed launch on a power outage in a computer. The launch was rescheduled for May 23. (*W Times*, May 23/93)

May 24: The ITAR-Tass news agency announced that a cargo ship loaded with food, water, fuel, and equipment had docked with the orbiting Space Station Mir. The cargo ship also delivered a landing capsule to the two Mir astronauts, who had been aboard the Mir for four months. (AP, May 24/93)

- *Aviation Week & Space Technology* reported that a NASA advisory panel had found that the Hubble Space Telescope would have had even more component failure in orbit if the launch had not slipped from 1986 to 1990 as a result of the Challenger accident. The delay enabled technicians to do additional testing that revealed suspect parts. (*AvWk*, May 24/93)

- The AP reported that the nonprofit group SatelliLife, based in Cambridge, Massachusetts, last year had launched a low-orbiting satellite that “talks” to the Internet and coordinates the Healthnet message-relay service connected with the satellite. The service makes it possible for remote regions of the world to receive much-needed medical advice. (AP, May 24/93)

- NASA announced that a NASA F/A-18, modified to test the newest and most advanced system technologies, made its first research flight on May 21 at NASA’s Ames-Dryden Flight Research Facility, Edwards, California. The Systems Research Aircraft (SRA) was evaluating technologies that would benefit both civilian and military aircraft. (NASA Release 93-95; *Mojave Desert News*, May 27/93)

- A commentary in the *Houston Chronicle*, applauded NASA’s decision to financially penalize contractors who delivered defective products, did not meet schedules, or continually exceeded cost estimates. NASA’s proposed procurement reforms would do away with the “cost-plus” contracts under

which the government typically negotiated costs as a project moved along, rather than seeking bids and holding contractors to them. (*H Chron*, May 24/93)

May 25: NASA announced that the location of a third radiation belt of cosmic rays had been pinpointed several hundred miles above the Earth. A NASA satellite, orbiting 375 above the Earth, had mapped a portion of the new belt. (NASA Release 93-94; AP, May 25/93; *B Sun*, May 26/93)

- NASA announced that a task force established by NASA Administrator Daniel S. Goldin to review plans for the Hubble Space Telescope servicing mission had concluded that “the mission is achievable.” The servicing mission was currently scheduled for December 1993. (NASA Release 93-96)

- NASA announced that the Hubble Space Telescope had looked into the nucleus of a galaxy created by the collision of two galaxies and had discovered a pinwheel-shaped disk of gas surrounded by clusters of young stars born as result of the collision. “This may unlock the key for understanding how all globular clusters formed in ellipticals,” said Dr. Brad Whitmore of the Space Telescope Science Institute, Baltimore, Maryland. (NASA Release 93-97; *USA Today*, May 26/93; *NY Times*, May 26/93; *W Post*, May 26/93; UPI, May 25/93)

- The *Washington Times* reported that a conference of scientists and policy makers had discussed the question of what to do with the “junk science” that makes its way into public policy. The conference, which was held in the Washington, DC area, was sponsored by the International Institute of George Mason University and the Science and Environmental Policy Project. (*W Times*, May 25/93)

- The *Houston Chronicle* reported on a new nationwide poll of registered voters conducted by Yankelovitch Partners and sponsored by NASA contractor Rockwell International Corporation. The poll revealed that 70 percent of American voters supported the construction of a permanently staffed Space Station and 63 percent believed that the United States should spend “whatever is necessary” to preserve its lead in space activities. Some of the poll results, however, reflected wide swings of support for the space program. (*H Chron*, May 25/93)

- The *Plain Dealer* reported that a group of African American employees at NASA’s Lewis Research Center had charged that the materials used in a pilot program intended to promote better communication between employees of differing cultural groups instead fostered racism. NASA was investigating. (*The Plain Dealer*, May 25/93; *Space News*, May 31-June 6/93)

- NASA announced that the Magellan spacecraft had successfully completed its mission of radar-mapping the planet Venus and was beginning a new 80-day

maneuver that would put it in a more circular orbit around Venus. The new mission would give scientists a better understanding of the planet's interior and its atmosphere. (NASA Release 93-98; RTW, May 25/93; AP, May 25/93; *NY Times*, May 27/97)

- An improperly etched spring in one of Space Shuttle Endeavour's three oxygen turbopumps could delay next week's planned launch of the Space Shuttle. The inspection stamp was etched in a high-stress area rather than in a spot with minimal stress, NASA officials said. The spring holds the pump bearings in place. If the improperly marked spring broke at liftoff, the affected bearing cage could come loose. (AP, May 25/93)

- A NASA panel recommended that the Space Agency plan two Space Shuttle missions rather than the scheduled one to repair the Hubble Telescope. The panel agreed that the repairs could be done, but suggested that because of the complexity of the task, a back-up mission should be planned. (UPI, May 25/93; AP, May 25/93)

May 26: NASA announced that almost 15 years after they were launched, the Voyager 1 and 2 spacecraft had discovered the first direct evidence of the heliopause, the boundary that separates Earth's solar system from interstellar space.

Since August 1992, radio antennas on the spacecraft had been recording intense low-frequency radio emissions coming from beyond the solar system. Scientists concluded that the radio waves had been produced by electrically charged gases, or plasma, from the Sun interacting with cold gases from interstellar space at the edge of the solar system, a boundary known as the heliopause. A member of the Voyager science team said, "Our assumption that it is the heliopause is based on the fact that there is no other known structure out there that could be causing these signals." (NASA Release 93-099; *USA Today*, May 27/93; *NY Times*, May 27/93, May 30/93; *W Times*, May 27, 1997; AP, May 27/97; UPI, May 26/97; RTW, May 26/97; *W Post*, May 31/93; *B Sun*, June 8/93)

May 27: NASA Goddard Space Flight Center, Greenbelt, Maryland, announced that it had selected NSI Technology Services Corporation, Fairfax, Virginia, for negotiations leading to the award of a cost-plus-award-fee contract for integration and test support services. The contract, which covered seven years, had an estimated value of \$200 million and would provide services to all of Goddard and portions of NASA's Wallops Flight Facility, Wallops Island, Virginia. (NASA Release C93-e)

- The *Washington Post* reported that NASA had requested an 18 percent increase in 1994 for aeronautics research. If granted this amount would be the largest jump for aeronautics in decades. Increased funding would be used to

increase funding on a “environmentally friendly” supersonic jetliner, new materials and methods to make routine air travel safer and cheaper, advances in supercomputers, and upgrades to old wind tunnels to be used by U.S. companies for testing. (*W Post*, May 27/93)

May 28: Reuter reported that Arianespace had signed a contract for the launching of an Israeli Amos-1 telecommunications satellite by an Ariane rocket in 1995. (RTW, May 28/93)

- The magazine *Science* reviewed the three main redesigns of the Space Station, noting that the White House’s mandate that NASA produce a less costly station design had upset the U.S.’s international partners. (*Science*, May 28/93)

- *Science* reported that NASA had agreed that NASA and Russian scientists would cooperate in several research projects aboard the Russian Space Station Mir in 1994. The joint effort would be part of a scientific exchange signed by the United States and Russia last July. (*Science*, May 28/93)

May 29: The *Washington Times* reported that a Russian communications satellite had been lost in a low orbit after the booster rocket apparently ran out of fuel. (*W Times*, May 29/93)

May 30: In an article in the *Washington Post Magazine*, entitled “Has NASA Lost Its Way?” author Peter Carlson described his viewing of a Shuttle launch, which he called “inspiring,” and reviewed the history of Space Station Freedom. About the Space Station, he concluded, “So if they can cut the waste and trim the fat, if they can really do it cheaper, faster, better, then let them do it.” (*W Post*, May 30/93)

May 31: Reuter reported that Australian rocket scientists had completed the world’s first successful test flight of a model scramjet, a supersonic air-breathing engine that might make sub-orbital space flight common. (RTW, May 31/93)

- The *Washington Post* reported that the Space Station Freedom redesign team was struggling over a key issue: how to cut the facility’s costs while retaining enough power to make the facility worth building. In 1985, NASA engineers envisioned a power system that supplied 135,000 kilowatts (kW), far more than any other spacecraft. The basic outline of the original plan remained, but the planned capacity had dropped to about 57kW. President Clinton could select a new space design by mid-June. (*W Post*, May 31/93; *USA Today*, June 2/93)

- The *Washington Times* printed a letter from Richard A. Kerr, senior writer at *Science* and author of an article on ozone depletion in the magazine, in which

he disputed the *Times*' coverage of his article. Contrary to what the *Times* said, Kerr maintained that he did not in any way question the fundamental fact of ozone depletion, which, Kerr said, continues at a pace far faster than imagined 10 years ago. (*W Times*, May 31/93)

In May: The *Aviation Safety Journal* summarized some of the significant findings from the NASA Ames Fatigue Countermeasures Program. The research program was initiated in response to a NASA workshop requested by Congress in 1980 to examine possible safety problems caused by fatigue in air transport operations. The Ames study was continuing. (*Aviation Safety Journal*, Vol.3, No.1/93)

- NASA reported that NASA's Shuttle Mission, STS-57, scheduled for launch in early June, would highlight the beginning of a new era in the commercial development of space. The Endeavour's six-person crew was scheduled to retrieve a European satellite and also was scheduled to use experiments designed by and for students, operate a payload that might improve crystal growth techniques, and demonstrate possible on-Earth refueling techniques. (NASA Release 093-78)

June

June 1: The *New York Times* reported that astrophysicist Dr. E. Miles Standish Jr., writing in the *Astronomical Journal*, had concluded that astronomers could quit looking for the elusive "Planet X" because it was not there. The planet's existence was inferred from what seemed to be irregularities in the orbital motions of several known planets. Standish's analysis, however, demonstrated that the old calculations were erroneous. He was the first to make use of a new measurement of Neptune's mass made by Voyager in 1989. (*NY Times*, June 1/93)

- NASA announced that a remote-control technology used by Agency scientists to guide a robot in a recent cross-country test was being licensed to a private firm for commercial development. The name of the firm was not revealed. (NASA Release 93-100)
- NASA announced that the Agency was accepting applications for mission specialist and pilot astronaut positions effective immediately. The cut-off date for applications was July 1, 1993. (NASA Release 93-101)
- UPI reported that a solar-powered drill used to bore into icecaps on Earth could be used on a mission to Mars to collect ice samples from Mar's north pole. The drill would sample a core about three feet deep. The drill was scheduled to be used this summer to sample two ice caps in the Peruvian Andes. (UPI, June 6/93)
- The *Washington Post* reported that the U.S. Space & Rocket Center was operating two nonprofit Space Camps, one in Huntsville, Alabama, and the other in Florida, near the Kennedy Space Center. The programs at the camp were designed to encourage young people to think about careers in science, technology, and the aerospace industry when they grow up, or to encourage them to try to become astronauts. Since the program began in 1982, more than 150,000 students have graduated from the program. (*W Post*, June 1/93)

June 2: *USA Today* reported that the world's average temperature rose about one degree during the past year. Scientists writing in the National Geographic Society's *Research & Exploration* continued to disagree on the cause and effect of the temperature rise. (*USA Today*, June 2/93)

- Writing in the *Baltimore Sun*, Gwynne Dyer, syndicated columnist, described the plan for "terraforming" Mars held by a group of scientists loosely called "The Mars Underground." One of the leaders of the group was Christopher McKay of NASA's Ames Research Center in California.

The group had worked out a plan, based on currently available or at least easily imaginable technology, for turning Mars into a second Earth over a period of

280 years. Dyer concluded her discussion by noting that unless we take more care of our own earthly environment, we might well have to use some of the technology envisioned for Mars to maintain our own planet. (*B Sun*, June 2/93)

- NASA announced that the material that keeps the Space Shuttle from burning up when it returns from space may help treat medical problems on Earth. Researchers from NASA's Ames Research Center in California were working with physicians in San Antonio to determine whether the Space Shuttle's ceramic surface insulation materials could be used in bone transplants. (NASA Release 93-102)

- NASA announced that a new camera to fix the Hubble Space Telescope's blurry vision had been shipped from Jet Propulsion Laboratory in California, where it was built, for testing at Goddard Space Flight Center in Maryland. It was scheduled to be sent into orbit later in the year. (AP, June 2/93)

- NASA said that the launch of Space Shuttle Endeavour would be delayed for at least two weeks because the Shuttle's engine maker, Rocketdyne, had failed to correctly document whether one of the engine's parts was reliable. In a review of Rocketdyne's operation, NASA discovered many problems with how the company documented its work. In one case earlier in the year, a paperwork problem made it impossible for NASA to determine whether a Shuttle's engines contained proper seal retainers or older, phased-out models.

In addition, the review found cases where the general engineering drawings and instructions to Rocketdyne's assemblers were not as specific as they should have been. The situation led to "several hundred" discrepancies between engineering drawings and employees' workshop manuals. A company spokesperson said that some workshop manuals were being rewritten to eliminate discrepancies and ambiguities. (*O Sen Star*, June 2/93; *LA Times*, June 3/93)

June 3: Richard Martin Jones, an Australian computer hacker who closed down NASA's computer system for 24 hours, was placed on a good behavior bond. He was also ordered to complete 300 hours of unpaid community work. (RTW, June 3/93)

- The U.S. Postal Service unveiled a new \$2.90 stamp featuring the image of a futuristic spaceship. Deputy Postmaster General Michael Coughlin and ex-astronaut Robert Crippen, Director of the Kennedy Space Center, dedicated the stamp at a brief ceremony that was to have occurred the same day as the launch of Shuttle Endeavour. That launch was delayed for two weeks because of engine problems. (AP, June 3/93)

- A NASA official said that Rocketdyne might lose as much as \$29 million in profits on its Space Shuttle engine program because of manufacturing prob-

lems at its Canoga Park plant. The company could lose the funds, known as award fees, if NASA determined that the company had performed poorly between November and April. NASA was completing a review of Rocketdyne's Space Shuttle engine manufacturing operation. (*Daily News*, June 3/93)

- NASA announced that it had begun testing a powerful new engine for large subsonic passenger jets. The engine could cut fuel consumption up to 12 percent and significantly reduce engine noise. A NASA spokesperson said that the Advanced Ducted Propulsor (ADP) should be ready for use in commercial transport aircraft by the turn of the century. (NASA Release 93-103; UPI, June 3/97)

- An editorial in the *Houston Chronicle* criticized political opponents of a permanent U.S. Space Station, arguing that the Space Station's detractors risk costing this Nation its scientific and technological preeminence for decades to come. (*H Chron*, June 2/93)

- Thirteen high school students from Laurel, Maryland, took control of a 400-pound, \$20 million satellite as it beamed information for a solar particle study to NASA's Goddard Space Flight Center in Greenbelt, Maryland. To be on the safe side, a team of engineers stood by to make sure nothing untoward happened.

The day was the culmination of a two-year project designed to get more students interested in space; students had studied for two years before being allowed to operate the controls. (AP, June 3/93)

- The *Christian Science Monitor*, noting that Space Shuttle Endeavour's mission would symbolize what NASA called "the year of commercial space," reported that companies had been slow to exploit the commercial possibilities of space. For example, although NASA had leased 200 of the 300 locker spaces available on Spacehab's first six flights, the Agency had few customers for the other 100 lockers. (CSM, June 3/93)

June 4: NASA announced that the Space Station redesign team would submit its final report on three design options to the White House Advisory Committee on the Redesign of the Space Station on Monday, June 7. The three options included a modular concept that would use existing flight-proven hardware, a derivative of the current Space Station Freedom design, and a Space Station that could be placed into orbit with a single launch of a Shuttle-driven vehicle. (NASA Release 93-104; UPI, June 6/1993; AP, June 7/93; *NY Times*, June 6/93; *W Post*, June 6/93; *B Sun*, June 6/93)

- The magazine *Science* reported that some researchers were complaining that NASA was overselling its satellites' products. They cited as an example news

stories that fueled excitement about images of what NASA called black holes. Referring to an image featured on the front page of a November issue of the *New York Times*, one expert said that labeling the pictured cloud of dust a black hole was largely wishful thinking on the part of the observers and the backers of the space telescope. *Science* noted that outside astronomers often criticized NASA press releases, charging that they were misleading. (*Science*, June 4/93)

- The *Washington Times* reported that workers had replaced an engine pump on the Shuttle Endeavour in preparation for a planned mid-June launch. Endeavour had been scheduled for liftoff on June 3, but the launch was delayed because of engine problems. (*W Times*, June 4/93)

- NASA announced that Salisbury State University had become the first college in Maryland named to participate in a joint study program with NASA. The university was expected to receive a \$110,000 grant over three years from NASA's Joint Venture Institutions program. (*B Sun*, June 4/93)

June 7: NASA announced that June 20, 1993, had been set as the new launch date for the next flight of Space Shuttle Endeavour. The launch originally had been scheduled for June 3. (NASA Launch Advisory)

- NASA announced that recent discoveries from the Agency's Extreme Ultraviolet Explorer (EUVE) would be presented at the National Meeting of the American Astronomical Society, University of California at Berkeley on June 7 and 8.

The new results included discovery of elements that blanket the light from white dwarf stars, the detection of ionized helium in the local interstellar gas, the detection of an extreme ultraviolet shadow in the local interstellar medium, and new findings on the mysteries of rare extragalactic objects. (NASA Release 93-105; AP, June 8/93)

- A Russian would-be cosmonaut, now in the United States pursuing a doctorate in space policy at American University in Washington, was in Houston for three months on a U.S. government subcontract, helping two Russian cosmonauts prepare for flights in U.S. spaceships in 1993 and 1995. (*LA Times*, June 7/93)

- The *Wall Street Journal* reported that critics were warning that President Clinton's plan to redesign the Space Station might inadvertently end up killing the program because of concerns about cost estimates and technology. "I believe there's a real possibility [the Space Station] may not survive because of political considerations," said John Winch, a Boeing Company vice president. (*WSJ*, June 7/93)

June 8: NASA announced that its astronomers investigating how stars are born were using new instruments to observe clumps of interstellar gas that were about

to become new stars and planetary systems. The astronomers were using instruments developed for NASA's High Resolution Microwave Survey (HRMS), which was searching for radio signals that might be coming from technological civilizations on planets orbiting distant stars. (NASA Release 93-106)

- NASA announced that scientists had found water molecules frozen in the surface ices of Jupiter's Moon Io. According to Dr. Farid Salama, University of California, Berkeley, who led the project at NASA, "This is the first strong evidence of solid water on the surface of this satellite." (NASA Release 93-107; *NY Times*, June 15/93)

- The media announced that NASA had unveiled four designs for a scaled-down Space Station. None of the designs, however, could be built as cheaply as the White House had requested and still meet the orbital laboratory's main goals. The team presented cost figures ranging from a low of \$11.9 billion to \$13.3 billion to build the design that more completely resembled the Space Station Freedom. Three of these options were similar to the original design of the Space Station but achieved savings through reduction in hardware, management, and capability.

The design team also reported that NASA's estimate for the present design of the Space Station had been understated by some 10 percent because of costs that had been hidden throughout the Agency's budget. (*W Post*, June 8/93; *NY Times*, June 8/93; *LA Times*, June 8/93; *W Times*, June 8/93; *B Sun*, June 8/93; *USA Today*, June 8/93; AP, June 8/93; RTW, June 7/93; UPI, June 7/93; *WSJ*, June 8/93)

- The *New York Times* reported that at a meeting of the American Astronomical Society, Dr. Douglas N.C. Lin of the University of California at Santa Cruz had described the Milky Way as practicing "galactic cannibalism." Lin explained that the gravitational force of matter in the vast halo encompassing the Milky Way Galaxy was causing the Milky Way to consume the stars and gases of its nearest galactic neighbor, the Large Magellanic Cloud 160,000 light-years away. (*NY Times*, June 8/93; *LA Times*, June 8/1993; *USA Today*, June 8/93; *B Sun*, June 8/93; *P Inq*, June 8/93)

- The *Washington Post* published a letter from James E. Hansen, Director, NASA Goddard Institute for Space Studies, in which he charged that a *Washington Post* article, "Greenhouse Effect Seems Benign So Far" [front page, June 1], misrepresented his views. The article depicted the scientific understanding of the human-made greenhouse effect as a retreat from earlier predictions that global warming threatened the Earth's environment. In fact, according to Hansen, computer models confirmed that the Earth's climate is "sensitive and can be expected to warm about five degrees Fahrenheit when human-made greenhouse gases reach an amount equivalent to a doubling of atmospheric carbon dioxide." (*W Post*, June 8/93)

- The newly released proposals to redesign Space Station Freedom drew mixed reviews on Capitol Hill, with supporters praising the effort and detractors citing the cost of the project as further evidence that it should be abandoned. (*W Post*, June 9/93; *LA Times*, June 9/93; *USA Today*, June 9/93; *P Inq*, June 9/93; AP, June 9/93; APn, June 8/93; RTW, June 8/93; *H Chron*, June 9/93; *H Post*, June 10/93)

June 9: NASA announced that astronomers working with the Hubble Space Telescope had some success in their attempts to measure the Hubble Constant and the age of the universe. The Hubble Constant (HO) is the ratio of the recession velocities of galaxies to their distances in the expanding universe. The age of the universe can be estimated from the Hubble Constant and currently is thought to lie between 10 and 20 billion years. A more precise measurement of the Hubble Constant is required to narrow this range. (NASA Release 93-108; *P Inq*, June 10/93; RTw, June 9/93)

- NASA's Hubble Space Telescope (HST) discovered a group of stars that apparently had been cannibalized of their cooler outer gas layers by other passing stars, resulting in stellar "naked cores" with surface temperatures five times hotter than Earth's Sun. (NASA Release 93-109; *NY Times*, June 10/93; *P Inq*, June 10/93; *B Sun*, June 10/93; *LA Times*, June 10/93; AP, June 10/93; *Science*, June 14/93)

- The *Washington Post* reported that the panel advising the White House on redesigning the Space Station had suggested that the proposed astronaut outpost be launched into a "world orbit" where it could be reached not only by American Space Shuttles but also by Russian, Japanese, and Chinese rockets. (*W Post*, June 9/93)

- *USA Today* reported that the Superconducting Super Collider, a 53-mile circular tunnel being built outside Dallas, might not survive the congressional budget cutters. The 11 billion, over-budget science project was being targeted by congressional Democrats. (*USA Today*, June 9/93)

- The *Washington Post* reported that two separate investigations of a failed Atlas rocket launch last March had concluded that the mishap was caused by the loosening of a tiny screw that helps regulate the flow of liquid oxygen propellant. The completion of the investigations allowed General Dynamics Corporation, the company that built the rocket, to resume launches. (*W Post*, June 9/93; *USA Today*, June 9/93; *H Chron*, June 9/93)

- NASA described the STS-61 Space Shuttle Endeavour mission, scheduled for December, as the "most complicated repair mission ever attempted." The seven astronauts aboard Endeavour were scheduled to attempt to service and

repair the Lockheed-built Hubble Space Telescope. Crew members were to repair the telescope's primary mirror, which had a distorted spherical mirror, as well as do regular maintenance work on the telescope. (*Flight International*, June 9-15/93; *B Sun*, June 17/93)

June 10: The House Space, Science, and Technology Committee passed a \$15.16 billion authorization for NASA, in effect rejecting the attempt to kill the Space Station. The authorization would give the Space Station \$1.9 billion a year for the next six fiscal years and \$1.3 billion in the fiscal year 2000. Congressional opponents of the station, however, vowed to take the fight to the House floor. (*NY Times*, June 10/93; *LA Times*, June 10/93; *USA Today*, June 10/93; *AP*, June 10/93)

- The Federal Aviation Administration authorized civilian pilots to use a satellite-based navigation system that would enable them to choose direct routes without relying on navigational aids on the ground. The system, the Global Positioning System, uses a network of 24 satellites orbiting 11,000 miles above the Earth. Each satellite sends out a continuous signal that can be computed by receivers to determine an exact position. (*NY Times*, June 10/93)
- A Deutsche Aerospace AG (DASA) executive called on Europe and the United States to cooperate in setting quotas for launches of Russia's Proton Booster rocket until such time as market economy conditions prevailed in Russia. Werner Heinzmann, president of DASA's space systems group, told a news conference that currently the Proton costs only a fraction of a western launcher because of the value of the rouble. (*RTW*, June 10/93)
- The press reported that the House Appropriations Sub-Committee on Energy and Water had appropriated \$629 million for the Superconducting Super Collider for fiscal year 1994. The Clinton administration had requested \$640 million for the Collider. (*UPI*, June 10/93)

June 11: NASA announced that on June 13 Pioneer 10 would celebrate the tenth anniversary of becoming the first spacecraft to explore beyond the orbit of Pluto, the most distant solar system planet as yet discovered. (NASA Release 93-110; *W Times*, June 12/93)

- *Sky and Telescope* magazine sponsored a contest to choose a more accurate name than "big bang" to describe the creation of the universe. (*NY Times*, June 11/93; *AP*, June 11/93; *LA Times*, June 11/93; *W Post*, June 16/93)
- The *Los Angeles Times* reported that congressional supporters of the proposed Space Station were warning that the project would face serious trouble if President Clinton supported a radical, low-cost design. Supporters of the Station made it clear that they supported the most elaborate and expensive of

the three redesigns developed by NASA. This design, which would cost \$13.3 billion over the next five years, would cut more than \$4 billion from the cost of the Station, yet it would keep most of the Station's capabilities and make use of much of the work that NASA had done on the project over the last nine years. (*LA Times*, June 11/93)

June 12: In a report delivered to the White House, a panel appointed by the President said it found the two cheaper options for a Space Station to be the "most deserving of further support." However, according to press reports, the most expensive option and the one that most resembled Space Station Freedom was the design favored by the majority of the members of the House Committee on Science, Space, and Technology. (*W Times*, June 12/93; *C Trib*, June 13/93)

- Intelsat and Martin Marietta reached a tentative settlement of lawsuits connected with a communications satellite that Space Shuttle astronauts rescued after it was stranded in low orbit. The lawsuit stemmed from Martin Marietta's 1990 launch of a \$157 million Intelsat satellite, which went into a low, useless orbit after a Martin Marietta rocket launcher failed. Spacewalking astronauts attached a new rocket booster package to the satellite in May 1992, and the satellite then fired itself into its proper orbit. (*W Times*, June 12/93; *W Post*, June 12/93)

June 13: Two NASA scientists told a meeting of the American Astronomical Society that a cosmic collision as powerful as the one that many scientists think killed all the dinosaurs on Earth 65 million years ago may take place on the planet Jupiter in 1994. The scientists speculated that the impact might come from the comet Shoemaker-Levy, which last year came so close to Jupiter that the planet's powerful gravitational field shattered the comet into about a dozen large chunks. Recent calculations show that most of the comet's remaining chunks may hit Jupiter in July 1994. Because of uncertainties about the comet's orbit, however, it was possible that the collision might not occur at all. (*C Trib*, June 13/93; *P Inq*, June 20/93; *W Post*, June 28/93)

June 14: NASA announced that it had selected the Universities Space Research Association, Columbia, Maryland, to negotiate a cost-plus-fee contract for the Visiting Scientists Program at Goddard Space Flight Center, Greenbelt, Maryland. The five-year contract was expected to take effect September 1, 1993; the proposed cost for the five-year period was \$31 million. (NASA Release C93-g)

- *USA Today* reported that an article in *Florida Today* suggested that cuts in quality-control staffs at NASA and workers' fear of admitting error were creating potentially deadly problems for the Space Shuttle program. (*USA Today*, June 14/93)

- NASA announced that the Goddard Space Flight Center, Greenbelt, Maryland, had selected Fairchild Space and Defense Corporation of Germantown, Maryland, for negotiations leading to the award of a cost-plus-award-fee contract. The seven-year, \$91 million contract would provide instrument support services to the Engineering Directorate at Goddard. (NASA Release C93-h; *W Post*, June 15/93)

- Donald K. Slayton, one of the original seven American astronauts, died June 13 at his home in League City, Texas, of brain cancer. He was 69.

Mr. Slayton, known by the nickname Deke, was assigned to fly the second Mercury mission in orbit in May 1962 but was grounded two months before the mission because of an abnormal heartbeat. His heart condition cleared up in 1971, enabling him to qualify for the last available seat on the last Apollo mission.

The *New York Times* notes that other astronauts and space officials say that Mr. Slayton probably had a greater influence on the American space program over a longer period of time than any other single astronaut. For many years, he served as chief of flight operations at the Johnson Space Center and in that position was in charge of astronaut training and chose crews for nearly all missions. He retired from NASA in 1982. At the time of his death, he was director of Space Services Inc., a company that launched small satellites.

A memorial service was scheduled for June 19 at the Johnson Space Center. (UPI, June 13/93; RTW, June 13/93; *NY Times*, June 14/93; *W Times*, June 14/93; *USA Today*, June 14/93; *W Post*, June 14/93, June 20/93; *B Sun*, June 14/93; *P Inq*, June 14/93; *WSJ*, June 14/93; AP, June 14/93)

- Ten years ago this week, the United States sent its first woman, Sally Ride, into space. Ride, who flew in space twice, is a physics professor and director of the California Space Institute. (AP, June 14/93)

- *Aviation Week & Space Technology* magazine reported that the White House had begun to review the various options for redesign of the Space Station. There were reports that the President might be wavering in his support for the Station and perhaps would be willing to sacrifice it for his broader economic goals. (*AvWk*, June 14/93)

June 15: Space Shuttle Endeavour was scheduled to blast off June 20 on a seven-day mission that included an attempt to retrieve a science satellite, the European Retrievable Carrier (EURECA), and a spacewalk to prepare for the Hubble Space Telescope repair mission. The Shuttle was also carrying the world's first commercial space laboratory, Spacehab, which had on board 22 experiments underwritten by NASA. (*USA Today*, June 17/93; *B Sun*, June 17/93; UPI, June 17/93; AP, June 17/93)

June 16: The *Los Angeles Times* reported that, according to congressional aids, President Clinton had decided to push for construction of a sophisticated,

orbiting space laboratory that would make use of much of the technology already developed for Space Station Freedom. The President appeared to hint at this decision in a June 15 press conference. (*LA Times*, June 16/93)

- NASA announced that a specially modified NASA F-15 research aircraft had arrived at the Ames-Dryden Flight Research Facility, Edwards, California. The F-15 was to be involved in a research program aimed at substantially advancing the cruising efficiency and flight maneuverability of future U.S. aircraft. (NASA Release 93-115)

- Guion Bluford Jr., America's first African American astronaut in space, was scheduled to leave NASA in July to join NYMA, Inc., a Greenbelt, Maryland, engineering and computer software company. (*USA Today*, June 16/93; NASA Release, 93-113)

- White House officials said that President Clinton had decided to proceed with a slightly slimmed down version of the original Space Station Freedom design. The Space Station was expected to cost about \$10.5 billion over five years. (RTW, June 16/93; *NY Times*, June 17/93; *USA Today*, June 17/93; AP, June 17/93)

- A European Space Agency official said that a re-usable science satellite scheduled to be rescued during Space Shuttle Endeavour's mission next week would be mothballed after astronauts returned it to Earth and experiments were removed from it. The satellite was scheduled to be flown four more times, but there was no budget for additional flights. (RTW, June 16/93)

June 17: Scientists writing in the journal *Nature* suggested that multiple meteorites, rather than one big meteorite, might have caused the extinction of dinosaurs. (*P Inq*, June 17/93; *NY Times*, June 22/93)

- Writing in the *New York Times*, author John Lukacs called the proposed \$8.4 billion Super Collider in Texas "super nonsense." He labelled as outdated the view held by proponents of the Super Collider that science might discover the smallest building block of the universe and that the universe could be explained by a Grand Unified Theory. (*NY Times*, June 17/93)

- An editorial in the *Baltimore Sun* urged President Clinton to give a "strong go-ahead" to the building of Space Station Freedom. (*B Sun*, June 17/93)

- President Bill Clinton announced that he would ask Congress to support a scaled-down version of Space Station Freedom and would attempt to broaden international participation in the program. Clinton said that he would also support the Superconducting Super Collider project. (RTW, June 17/93; UPI, June 17/93; *W Post*, June 18/93; *LA Times*, June 18/93; *USA Today*, June 18/93)

18/93; *NY Times*, June 18/93; *W Times*, June 18/93; *B Sun*, June 18/93; *WSJ*, June 13/93; *AP*, June 18/93)

June 18: NASA announced the selection of 100 minority high school students to participate in a new NASA education program called SHARP PLUS Research Apprenticeship Program. The program is a collaborative effort between NASA, Historically Black Colleges and Universities, and aerospace and other industries to increase opportunities for minority students interested in careers in mathematics, science, and engineering by offering research apprenticeships. (NASA Release 93-116)

June 20: NASA delayed the launch of Space Shuttle Endeavour, scheduled to blast off on June 20, because of poor weather at Cape Canaveral, Florida. A second launch attempt was expected for Monday morning, June 21. (RTW, June 20/93; UPI, June 20/93, June 21/93; *Ap*, June 21/93; *NY Times*, June 21/93; *LA Times*, June 21/93; *W Post*, June 21/93; *USA Today*, June 21/93; *W Times*, June 21/93; *B Sun*, June 21/93)

- Robert McClure of Dominion Astrophysical Observatory in Victoria, British Columbia, said that Canadian and U.S. astronomers had used a telescope on Mauna Kea, Hawaii, to obtain the first clear pictures showing galaxies colliding and merging on "a really grand scale." The pictures supported a theory that postulates that elliptical galaxies were formed by galactic mergers such as those observed. (*W Times*, June 20/93)

June 21: The International Astronomical Union in Cambridge, Massachusetts, said that an asteroid had come within 90,000 miles of Earth last month without being detected. This was the closest encounter ever recorded. The asteroid, named 1993 KA2, was discovered by asteroid hunter David Rabinowitz. (*W Post*, June 21/93; *P Inq*, June 21/93)

- The Danish industry ministry announced that Denmark was scheduled to take part in a scientific satellite project in cooperation with NASA in 1995. The project involved the launch of a small Danish satellite into orbit to study Earth's magnetic field. (RTW, June 21/93)

- In mid-June a new breed of spacecraft, the Delta Clipper XI (DC-X), was scheduled to be launched for a brief test. If things go according to plan, the craft would hover briefly 100 feet in the air, and then settle back in its launching pad. The spacecraft, built by McDonnell Douglas Aerospace, was to take off vertically and land the same way. Some experts in the field suggested that the DC-X might mark the next phase of U.S. space exploration. (*Business Week*, June 21/93)

- NASA announced that it and the National Institute on Deafness and Other Communication Disorders (NIDCD) had selected a proposal from a consortium

of institutions to place the Center for Vestibular Research at Northwestern University, Evanston, Illinois. The center would work on defining the contributions of the vestibular system to the control of balance, posture, and locomotion through ground-based and space-based studies. (NASA Release 93-111)

- NASA announced that 40 college students had started a six-week Space Life Sciences Training Program at NASA's Kennedy Space Center, Florida. The summer residence training program was for college students interested in life sciences, bioengineering, ecology, or related fields. (NASA Release 93-117)

- Space Shuttle Endeavour blasted into space on June 21, after a one-day launch delay. The shuttle's mission was multipurpose, featuring experiments in the world's first commercial research laboratory, Spacehab; the retrieval of a European science satellite; and a spacewalk geared to preparing astronauts for the Hubble Space Telescope repair mission scheduled for December. (UPI, June 21/93; AP, June 21/93; RTW, June 21/93; *USA Today*, June 22/93; *NY Times*, June 22/93; *W Post*, June 22/93; *LA Times*, June 22/93; *W Times*, June 22/93; *B Sun*, June 22/93)

- The House Science, Space, and Technology Committee voted June 9 to prevent NASA from moving approximately 90 Space Shuttle jobs from Marshall Space Flight Center in Huntsville, Alabama, to Johnson Space Center in Houston. (*Space News*, June 21-27/93)

June 23: NASA announced that, despite transmitting problems, the onboard data recovery system of Space Shuttle STS-56 had captured 103 orbital sunrises and sunsets observed by the Atmospheric Trace Molecule Spectroscopy (ATMOS) instrument aboard the Shuttle. (NASA Release 93-118)

- President Clinton thanked the crew members aboard Space Shuttle Endeavour for giving "a great deal of credibility" to his attempt to save the Space Station. The President called the crew on Tuesday, June 22. (*USA Today*, June 23/93; *NY Times*, June 23/93; *W Times*, June 23/93)

- A *New York Times* editorial recommended that Congress eliminate the Space Station program because of the need to find deeper budget cuts and the fact that the program looked "more like pork-barrel spending for the aerospace industry than an exciting technological venture." The editorial noted that cutting the program would force the Nation to reassess just what role humans should play in space. (*NY Times*, June 23/93)

- A Department of Energy draft report said that the Superconducting Super Collider program had racked up at least \$216 million in unreasonable sub-contractor expenses. (*W Post*, June 23/93)

- The House Appropriations Committee adopted a revised space budget that fully funded the redesigned Space Station but called for large cuts elsewhere in NASA's budget. (*WSJ*, June 23/93)
- The *Washington Times* reported that Space Shuttle Endeavour had to delay firing a jet to avoid possibly coming in contact with a piece of space trash, in this instance, a 27-year-old spent Russian rocket. This was the fourth time in two years that Shuttle astronauts had to take measures to avoid trash in space. There were hundreds of thousands of pieces of trash floating in space as a result of space missions. (*AP*, June 23/93; *W Times*, June 24/93; *NY Times*, June 24/93)
- By a one-vote margin, the House of Representatives voted to fund Space Station Freedom. As a result of a 216-215 vote, the program escaped an attempt by budget-cutting lawmakers to scrap the multibillion-dollar project. (*WSJ*, June 24/93; *NY Times*, June 24/93; *LA Times*, June 24/93; *W Times*, June 24/93; *USA Today*, June 24/93; *AP*, June 24/93; *UPI*, June 23/94; *RTW*, June 23/93; *W Post*, June 24/93)

June 24: NASA announced that a NASA-University of New Hampshire study had revealed increased tropical deforestation and adverse effects on tropical forest habitat since the late 1970s. (NASA Release 93-119)

- NASA Administrator Daniel S. Goldin announced the appointment of two astronauts, William M. Shepherd and James D. Wetherbee, to senior management positions at NASA Headquarters, Washington, DC. (NASA Release June 24/93)
- The *Washington Post* reported that a White House official had indicated that President Clinton intended to retain NASA Administrator Daniel S. Goldin, a Bush appointee. The White House apparently had decided that Goldin was just the type of hard-nosed Administrator that NASA needed. (*W Post*, June 24/93; *UPI*, June 24/93)
- Responding to an Op-Ed piece by John Lukacs in the *New York Times* that attacked both the Super Collider and the field of particle physics, Edward Farhi, Professor of Physics, MIT, insisted that the Super Collider would open a new window on an energy range not yet explored by physicists, saying that it must be built if "progress is to proceed." (*NY Times*, June 24/93)
- Some members of Congress have introduced a bill that would bar space advertising. The bill would prohibit the transportation secretary from issuing launch licenses for any vehicles carrying materials to be used as ads in space. (*W Times*, June 24/93)
- Writing in the journal *Nature*, scientists reported that they think they have discovered a belt of asteroids in orbits so close to the Earth's orbit that many

of them may hit our planet at some time or other. However, most of these asteroids are so small that they will explode in space without doing any damage. (*NY Times*, June 24/93)

- Western Europe's Ariane 42P rocket deployed an American communications satellite into space on June 24. The rocket, which was launched from French Guyana after a long series of delays, was owned by the Los Angeles based Hughes Space and Communications Company. (RTW, June 24/93)
- The House of Representatives voted to kill the \$11 billion Superconducting Super Collider project. The project, which had President Clinton's support, was being built in Texas. The Super Collider, which was designed to discover sub-atomic particles that could provide clues to the origins of the universe, fell victim to political and budget pressures. (RTW, June 24/93; UPI, June 24/93; *NY Times*, June 25/93; *B Sun*, June 25/93; *W Post*, June 25/93)
- Officials said that talks between Vice President Al Gore and Russian Prime Minister Viktor Chernomyrdin to discuss mutual space exploration had been put off indefinitely because of friction over a \$400 million contract for Russia to sell rocket engines to India. (UPI, June 24/93; RTW, June 25/93)
- Writing in the *Chicago Tribune*, commentator Joan Beck called on Congress to kill the Space Station. She admitted that killing the project would cost jobs, but argued that doing so was necessary if progress were to be made in cutting back the deficit. (*C Trib*, June 24/93)

June 25: After making a final series of engine maneuvers that brought it within reach of the European Retrieval Carrier (EURECA), a free-flying platform of science experiments, the commander of Shuttle Endeavour plucked the satellite out of space and stowed it in the Shuttle's cargo hold for return to Earth.

Astronaut David Low fixed two stuck antennas on EURECA during a later spacewalk; during the walk, which was originally planned as an training exercise to prepare for the Hubble Space Telescope repair mission, he also twirled another astronaut around to test how difficult it would be to move large objects in space. Astronauts also worked, unsuccessfully as it turned out, on repairing a clogged line in a water-recycling experiment. (*W Post*, June 25/93, June 26/93; *LA Times*, June 25/93, June 27/93; *NY Times*, June 25/93, June 29/93; AP, June 25/93; RTW, June 25/93; *USA Today*, June 25/93, June 28/93; *B Sun*, June 26/93; *W Times*, June 26/93; *P Inq*, June 26/93; *P Inq*, June 29/93)

- Satellite research supported by NASA found that far fewer trees had been cut in the Amazon rain forest than previously assumed. However, the same study also found that three times as many animal and plant species were being killed or were near extinction than previously had been estimated. (AP, June 6/25; *W Post*, June 25/93; RTW, June 24/93; *NY Times*, June 29/93)

- Western Europe's second Ariane-5 booster was tested in a jungle clearing in French Guyana, space officials announced. The first Ariane-5 rocket was scheduled for launch in 1996. (RTW, June 25/93)

June 26: NASA unreeled 1,640 feet of copper wire above Earth and conducted electricity through the line in a space tether test. When refined, such tethers could be used to dispel electrical charges from spacecraft and change spacecraft orbits. The tether spool was carried into space by a Delta 2 rocket launched by the Air Force. (AP, June 26/93; RTW, June 26/93; *NY Times*, June 27/93; *W Post*, June 27/93)

- Roald Sagdeev, director of the Space Research Institute in Moscow from 1973-1988 and now professor of physics at the University of Maryland, and Michael Nacht, dean of the school of public affairs at the university, argued in a *New York Times* article that NASA should solicit Russian design help and begin plans to modify the Space Station's orbit so that it could be reached by launch vehicles from both the Kennedy Space Center and the Baikonur Cosmodrome. The authors also noted that a University of Maryland study commissioned by NASA found that a wider use of Russian technology could reduce costs by up to a billion dollars a year after the station was operational. (*NY Times*, June 26/93)

- A satellite was launched from Vandenberg Air Force Base carrying a military satellite designed to improve the accuracy of radars that track planes, missiles, space junk, shuttles, and other spacecraft. (AP, June 26/93)

June 27: Space School, a method of teaching math and science that uses space age technology to beam educational "adventures" into classrooms across America, was scheduled to open August 30. Space School lessons, which were to be carried on a delivery system called "distance learning," would be broadcast from a studio in Spokane, Washington, beamed up to a satellite, down to a receiver, and transmitted to a television in the classroom. Space School was to be operated and partially financed by the Young Astronaut Council, a non-profit organization started by the White House in 1985. (*Parade*, June 27/93)

June 28: NASA announced that during the first six months of their mission scientists using the U.S.-French TOPEX/Poseidon oceanographic satellite had recorded the most accurate measurements to date of global sea level changes. Oceanographers would use the data to calibrate computer models that help forecast future climate changes. (NASA Release 93-122)

- Writing in the *Los Angeles Times*, commentator James Flanigan made the case for funding the Space Station, reminding readers of the Vest Commission report, ordered last March by the White House. The report listed three main goals of the Space Station program: to learn about space travel, specifically

how human beings and materials react to prolonged weightless exposure; to gather technological and engineering knowledge; and to further international cooperation. (*LA Times*, June 28/93)

- The House of Representatives voted to maintain \$2.1 billion in funding for the scaled-down Space Station Freedom by a 220 to 196 vote. NASA Administrator Daniel S. Goldin attributed the growing support to an intense lobbying effort by the White House and congressional supporters. The project's chance of surviving the Senate vote were seen as good. (RTW, June 28/93; UPI, June 28/93; APn, June 29/93; AP, June 29/93; *W Post*, June 29/93; *LA Times*, June 29/93; *H Post*, June 29/93; *B Sun*, June 29/93; *W Times*, June 29/93; *NY Times*, June 30/93)

- A National Research Council (NRC) study found that Space Shuttle computer software programs were flawed by lax attention to safety by NASA engineers. Nancy Leveson, who headed the NRC committee that prepared the report, said that "many of the same kinds of mistakes that played a role in the Challenger accident are now being repeated with the Shuttle flight software." NASA, which requested the study, was considering some of the report's recommendations. (AP, June 28/93; *USA Today*, June 29/93; *B Sun*, June 29/93)

- Bad weather delayed the landing of Space Shuttle Endeavour at Kennedy Space Center. The landing was rescheduled for June 30, weather permitting. (UPI, June 29/93, June 30/93; *W Post*, June 30/93; *USA Today*, June 30/93; *NY Times*, June 30/93; *B Sun*, June 30/93; AP, June 30/93; RTW, June 30/93)

June 30: NASA Administrator Daniel S. Goldin hired two astronauts to fill senior management positions: William Shepherd, an ocean engineer and veteran of three Space Shuttle flights; and James Wetherbee, a former test pilot who had flown two Shuttle missions. They were scheduled to help lead the Agency's transition to a smaller, cheaper Space Station program. (*W Post*, June 30/93)

- An editorial in the *Washington Post* noted that in light of the budget deficit it was difficult to quarrel with Congress's decision to kill funding for the Superconducting Super Collider. By that same token, however, the Space Station deserved to be killed, especially because the Super Collider had the potential to contribute to human knowledge while the Space Station did not. (*W Post*, June 30/93)

- A team of Russian and French cosmonauts was scheduled to blast off to the Mir Orbital Space Station on July 1, for a three-week mission during which the team would carry out a series of medical and scientific experiments. This was the fourth joint Russian-French space mission since 1982. The mission

had been largely overshadowed by the space program's serious financial problems caused by the collapse of the Soviet Union. (RTW, June 6/30)

July

July 1: NASA announced that it had selected investigators to work on a new mission, called TIMED (Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics). The mission was to study the atmospheric regions that lie roughly between 40 to 110 miles (60 and 180 kilometers above the Earth's surface. The investigators come from four different universities, two of NASA's research centers, and four nonprofit research and/or industrial laboratories in the United States. (NASA Release 93-123)

- NASA announced that it had set July 17 as the launch date for the Space Shuttle Discovery's 17th flight. The nine-day mission of STS-51 was to include deployment of an Advanced Communications Technology Satellite (ACTS) and deployment and retrieval of the German-built ORFEUS-SPAS astrophysics free-flier. A six-hour space walk by two astronauts was also scheduled. (NASA Note to Editors N93-38)

- Energy Secretary Hazel O'Leary harshly criticized the management of the \$11 billion Federal Superconducting Super Collider project scheduled to be built in Texas. O'Leary said she was distressed by reports of wasteful expenditures, erroneous cost estimates, and the contractor's failure to cooperate with government auditors. She said she would move to replace the principal contractor, Universities Research Association, Inc. (URA), in the next 30 days. (*W Post*, Jul 1/93; *NY Times*, Jul 1/93)

- The *Los Angeles Times* reported that a dispute was brewing within NASA regarding who was to be assigned to the management team overseeing work on the redesigned Space Station. NASA Administrator Daniel S. Goldin was said to be looking for new blood on the management team. (*LA Times*, Jul 1/93)

- In letters to the editor of the *Baltimore Sun*, two Johns Hopkins University physics professors defended the importance of the Super Collider. Both writers said that the project represented basic research of the highest caliber and noted that its fate should not be tied to that of the Space Station. (*B Sun*, Jul 1/93)

- The Shuttle Endeavour landed at the Kennedy Space Center on July 1, after a two-day delay caused by bad weather. The Shuttle carried a science satellite the astronauts had retrieved in orbit.

Meanwhile, the crew of Shuttle Discovery was practicing for the Shuttle's next mission, scheduled to begin July 17. During the six-hour spacewalk planned for the mission, astronauts were to test Hubble Space Telescope repair tools. The Hubble repair mission was scheduled for December. (*AP*, Jul 1/93; *RTW*, Jul 1/93; *UPI*, Jul 1/93; *USA Today*, Jul 1/93; *NY Times*, Jul 2/93; *W Post*, Jul 2/93; *W Times*, Jul 2/93; *AkWk*, Jul 5/93)

- NASA Administrator Daniel S. Goldin told a Senate panel that Space Station Freedom needed to be everything from a scientific laboratory to “an inspiration to children.” Disagreeing with Goldin, Robert L. Park, representing the American Physical Society, argued that the “Space Station is unlikely to make any significant scientific contribution.” (AP, Jul 1/93, Jul 2/93)

- A team of Russian and French cosmonauts blasted off to the Mir Orbital Space Station on July 1, for a three-week mission. The team was scheduled to carry out a series of medical and scientific experiments and undertake three space walks. This was the fourth joint Russian-French space flight since 1982. (RTW, Jul 1/93; RT, Jul 1/93)

July 2: NASA announced that it had selected SYSCON Services, Inc., Washington, DC, for negotiations leading to the award of a contract to provide technical and support services at NASA's Ames Research Center, Moffett Field, California. (NASA Release C93-j)

July 3: A Soyuz spacecraft with a Russian-French crew docked successfully with the Mir Orbital Space Station on July 3. (RTW, July 3/93)

July 5: NASA said that the U.S.-French TOPEX/Poseidon satellite had revealed that sea levels dropped 12 inches off the East Coast during the period between October 1992 to March 1993 as cold winter air chilled the Atlantic Ocean and made the water contract. The satellite also found that sea levels rose 12 inches in parts of the Southern Hemisphere, where warm summer air heated the oceans and made the water expand.

According to Lee Fu, chief scientist of the \$706 million project at NASA's Jet Propulsion Laboratory, these measurements were the most accurate yet of global sea level changes and showed how sea levels were affected by both winds and seasonal temperature changes in ocean water. (AP, Jul 5/93)

- Donald Yeomans of NASA's Jet Propulsion Laboratory in Pasadena, California, said that “there is almost no question” that major chunks of the comet Shoemaker-Levy 9 would hit the planet Jupiter in late July of 1994. Astronomers planned to aim virtually every telescope in the world at Jupiter in late July to see what happens when big chunks of a shattered comet crash into the largest known planet at almost 40 miles a second. Astronomers predicted that the chunks would explode with the energy equivalent to almost a billion megatons of TNT. (*W Post*, Jul 5/93; *W Times*, Oct 5/93)

July 6: Senator James M. Jeffords and a group of House members last month introduced an amendment to the Commercial Space Launch Act of 1984 to prohibit the Department of Transportation from licensing a payload that would result in advertising from space. The amendment was in response to a proposal by Space Marketing Inc. of Roswell, Georgia, to launch a mile-long

inflatable billboard into space. The company planned to stuff the billboard in a satellite; after the satellite reached orbit, it would open and the billboard would jump out like "a giant life raft."

Opposition to the billboard was spearheaded by a lobbying effort, "Save Our Skies," put together by 30 state chapters of Public Interest Research Groups. (*W Post*, Jul 6/93; *C Trib*, Jul 7/93)

- John Bolton, a pioneer in radio astronomy, died at Buderim in Queensland, Australia. He was 71. Bolton was credited with having discovered, in 1947, the first radio "stars," galaxies that broadcast incredibly strong signals in radio wave length. (*NY Times*, Jul 20/93)

July 7: Shuttle builder Rockwell International Corporation announced that it would acquire Russian docking equipment for Space Shuttle Atlantis' planned linkup with Russia's Mir Space Station in 1995. Acquisition of the docking adapter was part of an agreement between the two countries that included flying a Russian cosmonaut on the Shuttle Discovery in November and sending an American astronaut to Mir for three months in 1995. (*AP*, Jul 7/93; *H Chron*, Jul 8/93))

- French Prime Minister Edouard Balladur said that European countries should attempt to cooperate on space projects because progress in technology was a way to assert themselves on the world stage. He made the comment after talking by satellite link with a French cosmonaut who was on a joint Franco-Russian mission. (*RTW*, Jul 7/93)

- NASA announced that it had awarded contracts to three U.S. aerospace companies to develop materials and materials fabrication technology for a future U.S. high-speed civil transport. Contracts went to Boeing Commercial Airplane Group, Seattle, Washington; Lockheed Aeronautical Systems Co, Marietta, Georgia; and McDonnell Douglas Aerospace, Long Beach, California. (NASA Release 93-124)

July 8: Texas Senator Kay Bailey Hutchinson pledged to fight for the survival of NASA's Space Station as she inspected a mockup of the proposed orbital base at the Johnson Space Center in Houston. (*H Chron*, Jul 8/93)

- Lowell Nesbitt, an artist who documented the Apollo 9 and 13 space launches for NASA, was found dead in his Manhattan studio on July 8. Death was attributed to natural causes. He was 59. (*UPI*, Jul 8/93)

- In an ironic twist, Space Station Freedom's "program office" in Reston, Virginia, which led the charge to cut waste and inefficiency in the space program, including warnings of cost overruns at Johnson Space Center in Texas, was said to stand the best chance of being eliminated as NASA

attempted to streamline the management of the Space Station program. (*H Chron*, Jul 8/93)

- Fred E. Weick, a pioneering aviation engineer and designer died of heart disease on July 8 in Vero Beach, Florida. He was 93.

NASA officials said that Mr. Weick's "genius touched almost every aeronautical discipline" for half a century. His career was devoted to making planes more aerodynamically efficient, safer, and easier to fly. A major innovation was his stable, tricycle-like landing gear, which became standard for virtually all aircraft, including the space shuttle. (*NY Times*, Jul 11/93)

July 9: NASA announced that it would participate in the National Association for the Advancement of Coloured People's (NAACP) national Afro-Academic Cultural, Technological, and Scientific Olympics (ACT-SO) competition, to be held in conjunction with the groups's annual convention in July. Two thousand high school students, representing 600 cities, were scheduled to compete for national honors. NASA scientists and engineers were to participate as science fair judges. National winners would receive certificates from NASA and a sponsored visit to a NASA Field Center.

Astronaut Bernard Harris, M.D., who completed his first Space Shuttle in May, was also scheduled to participate in several convention activities. (NASA Media Advisory)

July 11: Writing in the *Washington Times*, Representative George E. Brown, California Democrat and chairman of the House Committee on Science, Space, and Technology, argued that critics of the Space Station were themselves partially responsible for the delay, confusion, and high costs of the Station because of the annual sniping, redrafting, and retrenchment to which they have subjected the Space Station. Brown maintained that the United States needs the jobs provided by the Space Station, needs the scientific challenges of space-based design and engineering, and needs the emotional satisfaction of exploration and discovery.

Arguing the counter position, Representative Richard Zimmer, New Jersey Republican, said that the Space Station is "simply not worth the billions of dollars we have been asked to spend on it." He argued that many worthwhile scientific projects had suffered from lack of funding because money was being poured into the Space Station. (*W Times*, Jul 11/93)

- The state of Louisiana and NASA signed an agreement on June 24 in Baton Rouge reaffirming the commitment to transfer technology developed by NASA to businesses, industries, academic institutions, research labs, and individuals in Louisiana. The goal of NASA's technology transfer program is to ensure the widest possible information to potential beneficiaries. (*Picayne*, Jul 11/93)

July 12: NASA and Supra Medical Corporation, Chadds Ford, Pennsylvania, announced that they would jointly develop advanced ultrasound instrumentation. NASA planned to use the instrumentation for non-destructive evaluation of a new class of woven composite materials, and Supra Medical planned to use it to extend its high resolution capability for the non-invasive examination of the breast. (NASA Release 93-125)

- Writing in *Sports Illustrated*, Robert H. Boyle took to task those members of the media who have asserted that environmental problems such as depletion of the ozone layer and acid rain do not exist, that they were cooked up by scientists greedy for funding. Boyle pointed the finger at talk show host Ross Limbaugh but said that mainstream publications such as the *Washington Post* and the *Wall Street Journal* had also been guilty of misrepresenting environmental problems. (*Sports Illustrated*, Jul 12/93)

July 13: NASA announced that it had restructured the agreement under which Columbia leases the commercial C-band capacity on board two of NASA's Tracking and Data Relay Satellites (TDRS). Under terms of the restructured agreement, Columbia would share with NASA all revenues received from leasing capacity to third parties. (NASA Release 93-126)

- The United States and Russia appeared to be nearing a compromise in a dispute over a proposed Russian sale of rocket engines and associated technology to India. Under the expected compromise, Washington would allow Moscow to sell the rocket engines to India but halt the transfer of some associated technology that initially was to be a key part of the deal. The technology was meant to give India the capability to manufacture its own ballistic missile engines, which could be used for either military or commercial space launch vehicles. (AP, Jul 13/93; *W Post*, Jul 14/93; UPI, Jul 14/93)

- Guy Bluford, the nation's first African American astronaut in space, was scheduled to retire later in the month. Bluford, 50, who went on four Shuttle missions, planned to work for a Maryland aerospace company. (AP, Jul 13/93)

July 14: Writing in the journal *Nature*, U.S. scientist Walter Jaffe said that his team had taken pictures of a so-called nuclear accretion disk, which scientists have long theorized surrounds a black hole. The idea is that matter swirls around the black hole as it is being pulled in, forming an accretion disk, a flat ellipse resembling a round Danish pastry. The disk was discovered through use of the planetary camera on the Hubble Space Telescope. (RTW, Jul 14/93)

- NASA began the countdown for the planned weekend launch of Space Shuttle *Discovery* on a satellite-delivery and spacewalking mission. During the nine-day mission, the astronauts were to release an experimental communications satellite destined for a 22,300-mile-high orbit and an ultraviolet telescope to be retrieved six days later and returned to Earth. They also planned to test new navigation equipment

and conduct a spacewalk to try out tools needed for the Hubble Space Telescope repair mission in December. (AP, Jul 14/93; RTW, Jul 14/93; USA Today, Jul 15/93, Jul 16/93; P Inq, Jul 15/93; W Times, Jul 16/93; NY Times, Jul 17/93)

July 15: NASA's exhibit at the Experimental Aircraft Association Fly-in Convention and Sport Aviation Exhibition at Oshkosh, Wisconsin, from July 29 through August 6, was scheduled to focus on general aviation technology. The exhibit was to explain how NASA was addressing the challenges of aircraft in every speed regime. It also planned to stress how NASA's "customers," that is, the government, industry, universities, and, ultimately, the American taxpayer, benefitted from the Agency's advances in aeronautics. (NASA Release 93-128)

- The Russians, eager to hawk their space wares to the West, were scheduled to hold a conference on the Mir Space Station July 27 to July 28 at the Dulles Hyatt in Herndon, Virginia. Hosted by NPO Energia, manufacturer of the Mir, the conference is scheduled to cover all aspects of the platform. A large delegation was expected from the NASA Space Station redesign team. (*Washington Technology*, Jul 15/93)

- A NASA-developed automated air traffic control tool that could save airlines hundreds of millions of dollars was to be presented to aviation industry representatives at a briefing co-hosted by NASA and the Federal Aviation Administration scheduled for July 19-20.

The Center/TRACON Automation System (CTAS) helps air traffic controllers schedule arriving aircraft more effectively, starting when planes are still about 200 miles from an airport. (NASA Release 93-127)

- Pollution of the world's atmosphere could trigger huge temperature changes like those before the last Ice Age, the British journal *Nature* reported. Scientists examining glacier samples say that when temperatures during the last warm period rose an average of 3.8 degrees Fahrenheit above normal levels, they also started fluctuating by as much as 18 degrees Fahrenheit (USA Today, Jul 15/93; WSJ, Jul 15/93; W Post, Jul 19/93)

July 16: NASA announced that a team of astronomers had reported that recent NASA Hubble Space Telescope observations of a class of active galaxies further supported the theory that they are fueled by a massive black hole at the center. (NASA Release 93-130; RTW, Jul 16/93; W Post, Jul 17/93)

- Aaron Cohen, Director of the Johnson Space Center, announced that he had accepted an appointment as the Zachry Professor of Engineering at Texas A&M University and would retire from NASA on August 20. Cohen joined NASA in 1962. He became Director of the Johnson Space Center in 1986.

(NASA Release 93-131; AP, Jul 17/93; RTW, Jul 16/93; UPn, Jul 16/93; *W Post*, Jul 17/93)

- The United States and Russia reached a last-minute agreement on the sale of rocket engines and related technology to India. The deal would allow some of the rocket engines to be transferred to India but would limit the transfer of technology and would not impose any sanctions on Russia, (Reuters, Jul 16/93; APn, Jul 17/93)
- Brazil was scheduled to begin a campaign in July to fight the burning of the Amazon rain forest. The months from July to November make up the dry season in the Amazon, and clearing of the rain forest through burning largely occurs in that period. NASA has agreed to monitor fires through its satellites and other equipment. (Reuters, Jul 16/93)
- NASA Administrator Daniel S. Goldin announced that he had appointed Margaret G. Finarelli to be assistant for strategic planning. Prior to her appointment, she served as NASA's Associate Administrator for Policy Coordination and International Relations. (NASA Release 93-132)

July 17: NASA halted the countdown for Space Shuttle Discovery less than an hour before scheduled liftoff because of a bad electrical circuit controlling a set of launch pad safety locks. A second launch attempt was expected to take place no earlier than late next week. (AP, Jul 17/93; UPn, Jul 17/93; RTW, Jul 17/93; *USA Today*, Jul 19/93; *P Inq*, Jul 18/93; *NY Times*, Jul 17/93; *W Times*, Jul 18/93; *W Post*, Jul 18/93)

July 18: India announced that it would develop powerful rocket technology that it said it had been denied as a result of an accord between Washington and Russia. In that accord, Russia agreed to sell some rockets to India but, bowing to U.S. pressure, agreed not to provide India with the accompanying technology. (*NY Times*, Jul 18/93)

July 19: A team of astronomers using NASA's Hubble Space Telescope discovered a "double nucleus" in the center of the neighboring spiral galaxy M31, located in the constellation Andromeda. Hubble shows that the M31 nucleus is much more complex than previously thought, according to Dr. Todd R. Lauer of the National Optical Astronomy Observatories, Tucson, Arizona. (NASA Release 93-133; *NY Times*, Jul 20/93; CSM, Jul 20/93; *AvWk*, Jul 19/93).

- Responding to Alan Shepard's June 19 letter on the DC-X (Delta Clipper), Charles Conrad Jr., a former astronaut and staff vice president at McDonnell Douglas Aerospace, defended the concept behind the vertical-takeoff, vertical-landing vehicle. He also noted that by the time the vehicle would be operational it would not be a Shuttle replacement but would provide

an adjunct to the space lift capacity in the 20,000-pound-payload category. Conrad noted that the experimental vehicle was designed to be reusable, like aircraft. (*W Post*, Jul 19/93)

- In a *Time* magazine essay, Dennis Overbye advocated cooperating with the Russians in building the new Space Station. He suggested that the inclusion of Russia would breathe new life into the tired Space Station project. At the very least, he advocated that the Space Station go into a high-inclination orbit so that Russian spacecraft could visit from the Baikonur spaceport and perhaps perform rescue operations. (*Time*, Jul 19/93)
- After back-to-back failures, rocket-maker General Dynamics successfully launched a booster with a military communications satellite built to survive nuclear attack. The 15-story Atlas blasted off from Cape Canaveral, Florida. (*P Inq*, Jul 20/93)

July 20: As the Clinton administration urged the Federal research complex into doing more to help American businesses, experts said that it should take a lesson from what had happened with the \$600 million Advanced Communications Technology Satellite (ACTS), which was expected to be put into orbit shortly after the Space Shuttle Discovery got off the ground. Labeling the project a white elephant, critics said that the satellite had generated little or no interest among its main targets—American satellite builders, who said its gadgetry was either irrelevant to their needs or coming along far too late to be of any use.

Analysts said that the government should tread very carefully when it tried to help industry technically and that any programs that did materialize should be structured so that businesses paid a substantial part of the costs, creating an opening for the discipline of market mechanisms. (*NY Times*, Jul 20/93)

- The *Washington Post* reported that firms that did work relating to the Strategic Defense Initiative (SDI) in the past were attempting to turn their SDI-related discoveries to commercial use. For example, Photon Research Associates Inc. in Arlington, Virginia, worked on mapping the Earth's oceans and land masses so that space-based sensors could differentiate between incoming enemy missiles and the Earth in the background. The company switched to developing sensors for NASA that would study the planet's natural resources and to monitor pollution. (*W Post*, Jul 20/93)
- Writing in the *Los Angeles Times*, aerospace engineer James F. Glass advocated funding the Space Station, arguing that not only does NASA provide jobs and dreams, but it also keeps the country pulling together for America's future. He noted that when NASA, with all its faults, spends a dollar, the taxpayer usually receives a dollar's value. Ultimately, in Glass's view, the country needs to focus on more than survival; it must reach for the stars. (*LA Times*, Jul 20/93)

- At a public hearing on July 20, the National Transportation Safety Board described a scene of confusion in the mission control room during the launch of a Pegasus rocket made by Orbital Sciences Corporation of Fairfax, Virginia. Control room operators at a NASA command center in Wallops Island, Virginia, ordered the launch of the Pegasus from a B-52 bomber, then ordered the launch aborted, only to rescind that order seconds later. Federal safety officials want stricter controls over commercial satellite launches. (AP, Jul 21/93)
- NASA announced that it had selected Computer Sciences Corporation, Applied Technology Division, Falls Church, Virginia, to negotiate a contract for scientific computing operations, maintenance, and communication services in support of the Center Scientific Computing Complex (CSCC) at the Langley Research Center, Hampton, VA. (NASA Release C93-1; *W Times*, Jul 22/93)
- NASA managers set July 24 as the new launch date for Space Shuttle Discovery's Mission STS-51. A problem with the Pyro Initiator Controller (PIC) unit on the launch pad caused the Kennedy Space Center Launch Director to abort the launch attempt on July 17. (NASA Launch Advisory)
- An official of Japan's Science and Technology Agency announced that it would spend \$4.6 billion developing an unmanned Space Shuttle that would repair satellites, act as a space transporter, and serve as a laboratory for microgravity experiments. (RTW, Jul 7/93)

July 21: Charles H. Vermillion, chief of the international data systems office at NASA's Goddard Space Flight Center in Greenbelt, Maryland, was charged in a six-count indictment with violating Federal conflict-of-interest laws and converting government property to his own use. Vermillion, who said he was innocent, was charged with taking NASA-developed plans for a programmable frame synchronizer, assembling the synchronizers at his own plant, and selling them privately. (*W Post*, Jul 23/93)

July 22: Three cosmonauts, including one French person, landed in the Central Asian republic of Kazakhstan after a successful mission aboard the Russian Space Station Mir. The 22-day Russian-French mission was launched from the Baikonur cosmodrome in Kazakhstan on July 1 onboard a Soyuz TM-17 craft and two days later docked with Mir. (UPI, Jul 22/93; AP, Jul 22/93)

- NASA announced that the Agency, at the request of the Federal Emergency Management Agency (FEMA), had flown specialized sensors mounted in an airplane over portions of the midwestern states in an effort to gather information on the flood-damaged Midwest. FEMA planned to use the collected images to assist in charting flood-damaged areas, to boost the emergency management Agency's computer data base on the region, and to update flood insurance maps. (NASA Release 93-134)

- NASA said that it would try again Saturday morning, November 24, to launch the Space Shuttle Discovery on a nine-day flight. The mission was to feature two satellite releases, the retrieval of one of those satellites, and a spacewalk to test tools needed for the Hubble Space Telescope repair mission planned for the winter. (AP, Jul 22/93; RTW, Jul 22/93; *NY Times*, Jul 24/93)
- David Lux, project manager for the SR-71 "Blackbird" spy plane, which crisscrossed the globe on cold war spy missions, said that the plane had a new job helping NASA generate a database to be used by people who do aircraft design. He said that Blackbird would soon take to the skies to see if it were possible to eliminate or reduce sonic booms for future high-speed airliners. (UPI, Jul 25/93)

July 24: Computers halted Shuttle Discovery's countdown only 19 seconds before launch when they sensed a problem with one of the spaceship's two booster rockets. NASA said that the flight could not be rescheduled until sometime in the first week of August, after engineers had replaced a bad hydraulic power unit in the booster. It was the second launch delay. Five astronauts aimed to deploy an experimental communications satellite during the mission. (RTW, Jul 24/93; AP, Jul 24/94; UPI, Jul 24/93; *W Post*, Jul 25/93; *NY Times*, Jul 25/93; *W Times*, Jul 25/93; *USA Today*, Jul 26/93)

July 26: The *Washington Post* reported that U.S. and Russian scientists would meet in Washington during the week to discuss ways to cooperate on U.S. and Russian Space Stations and possibly merge the two stations in the late 1990s.

The *Post* said that Vice President Al Gore was leading the White House initiative on this subject. (RTW, Jul 26/93; *W Post*, Jul 26/93)

- Writing in the *Washington Post*, Boyce Rensberger identified two points of view on global warming. James Hansen, a Goddard Institute for Space Studies scientist, asserted that Earth's atmosphere has been warming since the mid-1970s. He said that his readings indicated that the lower atmosphere's average temperature rose by about a quarter of a degree Fahrenheit in the late 1980s before the eruption of Mount Pinatubo chilled the air. Christy and Roy Spencer of NASA's Marshall Flight Center have a different opinion. They maintain that, overall, there had been no warming trend.

Why the difference? Christy Spencer said that their data came from satellite readings taken over the entire globe while the data used by Hansen came from thermometers, most in industrial areas, which can be "heat islands" and hence give artificially high readings. Hansen countered that this factor had been taken into account in the readings and noted potential problems with the accuracy of the satellite readings. Rensberger concluded that, given such ambiguous results, the clamor to "do something" about global warming remains largely an emotionally guided phenomenon. (*W Post*, Jul 26/93)

- The Senate approved legislation during the previous week requiring the Smithsonian Institution to build a proposed annex to the National Air and Space Museum near Dulles International Airport. The bill already had passed the House, and President Clinton was expected to sign it. (*W Post*, Jul 26/93)
- A NASA study of safety in the Space Shuttle program found that honest mistakes go unreported if workers fear blunders can cost their jobs. The study found no major safety concerns but said managers had not bridged the communications gap identified in the investigation of the 1986 Challenger disaster. The report said that “exaggerated” news coverage of safety-related incidents led to the mistaken perception among workers that reporting incidents and mistakes might result in punitive action. (RTW, Jul 26/93)
- NASA Administrator Daniel S. Goldin notified employees in a memo distributed the previous week that the scaled-back Space Station would mean the loss of about 1,300 jobs among Federal workers alone. Space Station work involved 2,300 of NASA’s 24,000 employees. (AP, Jul 26/93; *Sp News*, Jul 26-Aug 1/93; *B Sun*, Jul 27/93)
- NASA began airborne mapping of Napa Valley to help winegrowers battle an aphid-like insect that nearly destroyed vineyards in France and California in the 19th century. Officials said a single-engine Cessna fitted with an electronic sensor would map 50 acres of the Robert Mondavi vineyards infected by phylloxera. (AP, Jul 7/93)
- NASA announced an August 4 launch attempt for the Space Shuttle Discovery. (RTW, Jul 7/93; *USA Today*, Jul 28/93)

July 27: NASA announced the assignment of Dr. John Cox as acting Deputy Director, Program and Operations, Space Station Freedom Program, and Robert Moorehead as chief engineer for the Office of Space Systems Development (OSSD), NASA Headquarters, Washington, DC. (NASA Release 93-136)

July 28: NASA announced that it was adapting an existing, cutting-edge x-ray system to improve inspections of aging aircraft while saving American industries money. The x-ray system, which combines TV-like scanning by x-ray beams with digital data acquisition, was originally intended for medical, dental, and other industrial purposes. NASA was to adapt the system to inspect aircraft wings, turbines, and propeller blades for corrosion, cracks, and disbonding. The system was developed by the Digiray Corporation. (NASA Release 93-137)

- Belgian scientists, using research from outer space, invented a new detection system they hoped would prevent crib deaths. Physics professor Manuel Paiva

monitored the breathing of astronauts during a Space Shuttle mission two months ago by using a custom-made space suit with special sensors built into the garment. Paiva said that he had used the same technique for babies by attaching the electronic sensors inside pajamas. The sensors are able to detect a range of respiration problems. Paiva said research had so far been promising but another six months were needed to complete the studies. (RTW, Jul 28/93)

- Arkansas Governor Jim Guy Tucker and Thomas J. Lee, Director of NASA's Marshall Space Flight Center, Huntsville, Alabama, signed a memorandum of understanding to conduct a joint effort to transfer NASA-derived and NASA-contractor-derived technologies to businesses, industries, academic institutions, research facilities, and individuals in the state. (NASA Release 93-138)

July 29: NASA selected Hughes STX Corporation, Lanham, Maryland, to negotiate a five-year contract, proposed at \$121.7 million, to provide support of computer systems management for Goddard Space Flight Center, Greenbelt, Maryland. (NASA Release C93-m)

- NASA selected AlliedSignal Technical Services Corporation, Greenbelt, Maryland, for negotiations leading to a cost-plus-award-fee contract, estimated at \$40.8 million, to provide Transportable Laser Ranging Systems for the Goddard Space Flight Center, Greenbelt, Maryland. The contract was to directly support Goddard's Satellite Laser Ranging (SLR) Mission. The SLR technique measures the round-trip flight time of very short laser pulses from ground-based stations to retro-reflector-equipped satellites. (NASA Release C93-n)

- A 240-pound Array of Low-Energy X-ray Imaging Sensors (ALEXIS) satellite was launched into orbit April 25 onboard an Air Force Pegasus rocket for the Los Alamos National Laboratory in New Mexico. Officials at the New Mexico laboratory had hoped to demonstrate that they could handle space missions faster, better, and cheaper than NASA. However, one of the satellite's four solar panels was damaged during the launch, and the satellite was deemed a loss.

Unmanned satellites frequently diagnose their own maladies, make adjustments needed to survive, and allow themselves to be reprogrammed in orbit. This is what happened to ALEXIS, which on July 5 was brought under control and a week later conducted its first experiment. Scientists now expect to get much of the data they seek from the damaged satellite. The craft uses six telescopes to capture x-rays that could reveal evidence of weapons proliferation, and it carries an experiment designed to determine how Earth's atmosphere distorts radio signals. (*LA Times*, Jul 29/93)

- The House of Representatives passed an amendment to the National Helium Act of 1960. The amendment judged the helium program as a case of government waste and voted to end its monopoly on sales to the space pro-

gram. The 1996 Act required NASA to buy its helium from the government-run reserve, even though it could be bought for as much as \$10 less per 1,000 cubic feet on the open market. The Senate was still considering the amendment.

In the same session, the House passed a bill authorizing NASA to spend \$30 billion over the next two years. (*W Post*, Jul 30/93; AP, Jul 29/93; Jul 30/93; *B Sun*, Aug 23/93; *NY Times*, Sep 21/93)

- The Goddard Space Flight Center in Greenbelt, Maryland hosted six three-day sessions of *Aerospace for Kids*, designed to teach children about aerospace technology and Goddard this summer. The program was to host 150 children over a six-week period this summer. (*Prince George's Sentinel*, Jul 29/93)

July 30: NASA negotiated with PRC, Inc. of McLean, Virginia, a sole source contract extension to provide data processing and telecommunications support for NASA Headquarters, Washington, D.C. (NASA Release C93-o)

- NASA astronaut Bernard A. Harris Jr., M.D. was scheduled to present a National Urban League (NUL) banner, flown on the STS-55 Space Shuttle mission, to NUL President John Jacob during the organization's opening keynote ceremony on Sunday, August 1, in Washington, DC. (NASA Media Advisory)

- Arkansas Governor Jim Guy Tucker and Thomas J. Lee, Director of NASA's Marshall Space Flight Center, Huntsville, Alabama, signed a memorandum of understanding to conduct a joint effort to transfer NASA-derived and NASA-contractor derived technologies to businesses, industries, academic institutions, research facilities, and individuals in the state. (NASA Release 93-138)

- NASA postponed a scheduled launch of Space Shuttle *Discovery* until August 12 because of the Perseid meteor shower. This was the third time the mission had been delayed. The Perseid meteor shower occurs each August; it was expected to be more intense than usual this August, raising the possibility that a spacecraft in Earth's orbit could be damaged by a piece of debris. (UPI, Jul 30/93; RTW, Jul 30/93; AP, Jul 31/93; *W Post*, Jul 31/93; *NY Times*, Jul 31/93; *B Sun*, Aug 4/93; *USA Today*, Aug 10/93, Aug 11/93, Aug 12/93)

- Reuters reported that British television had shown rare film of a string of Soviet space disasters, most of which were kept secret at the time by the Communist leadership. The film, which became available after the breakup of the Soviet Union, shows the "Nedelin explosion" that killed a top Soviet official in 1960, rescue workers trying unsuccessfully to revive three cosmonauts killed after the Soyuz 11 landing in 1971, and the wreckage of the Soyuz 1, in which Vladimir Komarov was killed in 1967. (RTW, Jul 30/93)

August

August 1: The media reported that NASA was working with the Federal Aviation Agency (FAA) and the manufacturers of aircraft to utilize new technology in general aviation in order to reduce the skill required for flying a light airplane. (*Sunday Post Crescent*, Aug 1/93)

August 2: The *Wall Street Journal* reported that the Grumman Corporation was under criminal investigation for allegedly overcharging NASA by as much as \$8 million; the probe threatened the company's eligibility for new Federal contracts. (*WSJ*, Aug 2/93; *AP*, Aug 8/93; *UPI*, Aug 8/93; *W Times*, Aug 3/93; *NY Times*, Aug 3/93)

- *Aviation Week & Space Technology* reported that NASA Administrator Daniel S. Goldin's shuffling of top Space Station officials had led to internal friction between NASA and officials at the Reston, Virginia program office for the Space Station. NASA's international partners in the Space Station were also reportedly concerned that they were not fully involved in key decisions involving the Station. (*AvWk*, Aug 2/93)

- Joseph R. Cipriano, associate director of the department's Energy Research Office, recommended that the department fire the project manager for the \$11 billion Super Conducting Super Collider, slash President Clinton's budget request, and "take a year... to fix problems." In a memo, Cipriano noted that morale was very low, confidence in existing management was practically non-existent, and cost and schedule trends were worsening at an alarming rate. A nonprofit group of research universities, Universities Research Association, Inc., was under contract to build the instrument. (*W Post*, Aug 2/93)

- The Hooker Telescope on Mt. Wilson in California, which once ranked as the world's biggest, was written off as an astronomical anachronism eight years ago. However, using the latest electronic sensors and image-enhancers, scientists and philanthropists led by Robert Jastrow of the Mt. Wilson Institute and the founder of NASA's Goddard Institute for Space Flight, were reported to be working to salvage the Hooker Telescope. Jastrow had raised \$250,000 for repairs and was seeking another \$250,000 to make the telescope useful into the 21st century. (*LA Times*, Aug 2/93)

- A Titan 4 rocket carrying an expensive military spy satellite system exploded minutes after liftoff from Vandenberg Air Force Base. This, the first failure of the four-year-old Titan 4 program, was a \$2-billion accident, said John Pike, director of the space policy project at the Federation of American Scientists in Washington, a liberal group that researches classified aerospace projects. Pike consistently has criticized U.S. spy satellites. The accident wiped out

most of the savings Congress took from the intelligence budget during the year. (RTW, Aug 2/93; AP, Aug 3/93; USA Today, Aug 3/93, Aug 4/93; LA Times, Aug 3/93; W Times, Aug 3/93; NY Times, Aug 3/93, Aug 4/93; W Post, Aug 3/93, Aug 4/93)

- August marked the 10th anniversary of the first use of NASA's Tracking Data and Relay Satellite System (TDRSS). The system consists of several satellites plus a ground station at White Sands, New Mexico. (*Onset Magazine*, Aug 2/93)

August 3: NASA announced that astronaut James P. Bagian, M.D., P.E., was taking a leave of absence from NASA to work as vice president of corporate development and medical affairs at Somanetics Corporation, Troy, Michigan. Bagian was scheduled to head up the company's clinical research activities. (NASA Release 93-139)

- NASA named astronauts Tamara E. Jernigan, Thomas David Jones, James S. Voss, and Ellen Ochoa as payload commanders on upcoming Space Shuttle missions. (NASA Release 93-140)

- NASA announced that scientists using the Earth-orbiting Compton Gamma-Ray Observatory had discovered a powerful pulsar that had become one of the brightest x-ray sources in the sky during the past two weeks. (NASA Release 93-141)

August 4: NASA announced that Goddard Space Flight Center, Greenbelt, Maryland, had selected Jackson and Tull Chartered Engineers of Washington, DC for negotiations leading to award of a cost-plus-award-fee contract for multidisciplinary research and development. (NASA Release C93-p)

- Writing in the *Washington Post*, writer Deborah Shapley predicted that the demise of the Superconducting Super Collider had brought to an end the United States' 60-year dominance in high-energy physics and, symbolically, in physical science in general. She reminded the reader of the importance of basic science and asked scientists to muster their courage and "argue... that the most basic forces of matter and the birth of the universe are things worth studying in themselves and worthy of support." (*W Post*, Aug 4/93)

- The *Houston Post* reported that a faulty command from Mission Control during a Shuttle flight a month ago caused sparks aboard Endeavour and knocked out power to some of its equipment. The six astronauts aboard the Shuttle were in no danger, and power was restored in 10 minutes. The incident, however, did lead NASA to convene a safety board meeting. (AP, Aug 4/93; *W Post*, Aug 5/93; RTW, Aug 4/93; UPI, Aug 4/93)

- President Clinton signed legislation on August 2 authorizing \$8 million for planning and design of a \$162 million National Air and Space Museum building near Dulles International Airport. (AP, Aug 4/93)

- The Russian foreign ministry announced that Russia had fully suspended a \$359 million contract to sell India rocket engines and the technology needed to make them. (RTW, Aug 4/93)

August 5: NASA's Mars Observer spacecraft returned its first image of Mars taken last week when the spacecraft was 3.6 million miles from the red planet. Mars Observer was to orbit Mars on August 24, and global mapping operations were scheduled to begin December 16. (NASA Note to Editors N93-43)

August 6: NASA announced that scientists from the University of Hawaii and NASA's Ames Research Center, Moffett Field, California, had determined that the planet Pluto is covered with surface ices that are 98 percent nitrogen. The scientists concluded that with such abundant nitrogen surface ice, Pluto's thin atmosphere must be primarily gaseous nitrogen. (NASA Release 93-142)

- A \$67 million weather satellite to track storms, floods, and environmental damage went into orbit aboard an Atlas-E rocket. It also was scheduled to be used to pinpoint the sites of plane crashes and shipwrecks. The NOAA-13 satellite reached its 541-mile-high orbit on schedule. The new satellite, which eventually was scheduled to replace the aging NOAA-11 satellite, was to circle Earth every 103 minutes and view the entire planet twice daily. (NY Times, Aug 10/93; RTW, Aug 10/93)

August 9: NASA ground crews began final preparations to launch the Space Shuttle Discovery on a satellite delivery mission. The liftoff was scheduled for August 12. Discovery was to carry two satellites. Five astronauts were scheduled to put one satellite in orbit to conduct advanced communications experiments. The other, a telescope, was to be let out of the cargo bay for several days of celestial observations, then captured and returned to Earth. (RTW, Aug 9/93; AP, Aug 9/93, Aug 10/93; W Post, Aug 10/93; UPI, Aug 8/93)

- Sotheby's auction house announced that it had agreed to sell more than 200 items from the Soviet space program, including the first Moon rock fragments ever to go up for sale. The items were being sold by family members of the top participants as well as the state factories that produced the space suits and capsules being offered for sale. The Russian government was not involved in the sale. (RTW, August 9/93; AP, Aug 11/93)

- NASA announced that researchers at the NASA Lewis Research Center, Cleveland, Ohio, had developed a new and unique group of ceramic processing chemicals that might revolutionize the ceramic industry. The new pro-

cessing chemicals might lead to high purity ceramic products that could better withstand temperatures over 2102 degrees F (1200 degrees Celsius). (NASA Release 93-143)

August 10: Negotiations between Grumman Aerospace Corporation and Federal prosecutors broke down as they sought to resolve long-standing allegations stemming from the "Ill Wind" defense contracting scandal. Grumman agreed to pay about \$20 million in penalties to settle a civil proceedings from the investigation, but said that the company wanted to simultaneously settle allegations that it had overcharged NASA on a computer contract. The prosecutors refused to settle, pending a Justice Department investigation of the NASA sources. (*W Post*, Aug 10/93)

- Jet Propulsion Laboratory (JPL) Magellan Project officials announced the successful first-of-a-kind experiment to "aerobrake" a spacecraft by dipping it into the atmosphere of a planet. The Magellan spacecraft's orbit was changed from highly elliptical to nearly circular by dragging it through the top of the thick Venusian atmosphere repeatedly over a period of 70 days, ending on August 3, 1997.

The maneuver required minimal use of thruster fuel. Because fuel weight increases a spacecraft's launching costs and limits how many science experiments it can carry, aerobraking might allow NASA to save fuel and money on future spacecraft and conduct explorations that otherwise would not be possible, according to Magellan's Deputy Mission Director. The experiment also made it possible to gain another year of science from an old craft already in space.

Scientists said that the new orbit would give them an opportunity to analyze the rolling molten interior of Venus and study the planet's dense carbon dioxide atmosphere. Continuing with the probe, however, was dependent on inclusion of the project in NASA's budget for next year. (NASA Release 93-144; AP, Aug 10/93)

- The first test flight of a reusable single-stage rocket, called the Delta Clipper Experimental, was scheduled to occur shortly at the White Sands test facility, a Federal site in the New Mexico desert. The 42-foot, 20-ton prototype was built by the McDonnell Douglas Corporation for the Defense Department. (*NY Times*, Aug 10/93)

- The *Wall Street Journal* reported on the efforts of Japan to develop its own aerospace program, especially its work in developing advanced ceramic composite materials that could help protect future Japanese planes and spacecraft. (*WSJ*, Aug 10/93)

- Clinton administration officials reported that the White House was completing plans to permit the export of U.S. rocket technology that had been restrict-

ed out of fear it would be used to develop ballistic missiles. The proposal to allow the sale of space technology under strengthened safeguards was part of a review of export policy ordered by President Clinton. (*LA Times*, Aug 10/93)

- NASA announced that during the third week in July it had delivered the first data sets from the Cosmic Background Explorer (COBE) to the National Space Science Data Center at Goddard Space Flight Center in Greenbelt, Maryland. As a result, researchers from around the world now have access to the COBE data that provided the scientific community with an unprecedented look at how the universe began. (NASA Release 93-145)

- Technicians reentered the engine compartment of Space Shuttle Discovery to replace what was believed to be a bad temperature sensor. The problem delayed some launch countdown preparations but, according to Shuttle Test Director Mike Leinbach, posed no threat to the launch, scheduled for the morning of August 12. (*B Sun*, Aug 12/93; *RTW* Aug 11/93, Aug 12/93; *UPL*, Aug 11/93; *P Inq*, Aug 12/93; *W Post*, Aug 12/93; *USA Today*, Aug 12/93)

- The *San Francisco Chronicle* reported that NASA was renewing its interest in aeronautics. In 1992, aeronautics accounted for about eight percent of NASA's \$14.3 billion budget; if the Agency got the funding it had requested, NASA planned to spend \$8.6 billion on aeronautics from 1994 through 1998—an increase of 50 percent. (*San Francisco Chronicle*, Aug 11, 1993; *LA Times*, Aug 25/93)

August 11: LTX Corporation announced that NASA's Jet Propulsion Laboratory (JPL) had taken delivery of a Synchro mixed signal test system for use in the radiation effects and testing laboratory in Pasadena, California. (PR NEWSWIRE, Aug 11/93)

August 12: The NASA Lewis Research Center, Cleveland, selected NYMA, Inc., Greenbelt, Maryland, for negotiations leading to the award of a contract for scientific, engineering, technical, administrative, and related support activities of Lewis' mission responsibilities. (NASA Release C93-q)

- Twenty-six Prince George's County, Maryland, students with physical, mental, or learning disabilities spent six weeks in a jobs program at NASA's Goddard Space Flight Center in Greenbelt, Maryland during the summer. The program, which was under the auspices of the President's Commission on Employment for Persons With Disabilities, aimed to steer more young people into fields like science, engineering, and computer programming. (*W Post*, Aug 12/93)

- Writing in *USA Today*, Senator Kay Bailey Hutchinson (R-Texas), noted that research planned for the Space Station program would help women. Research already scheduled for the newly redesigned Space Station would

address several women's diseases, from osteoporosis to ovarian and breast cancer to immune-system disorders. (*USA Today*, Aug 12/93)

- In a letter sent to the White House, five senators pressed the Clinton administration to maintain tight restrictions on the export of space-launch technology that could be used to develop ballistic missiles. The letter was signed by Senators Claiborne Pell (D-RI); Jesse Helms (R-NC); Jeff Bingaman (D-NM); John Glenn (D-Ohio); and John McCain (R-Ariz). (*LA Times*, Aug 12/93)

- Onboard computers aborted the launch of Space Station Discovery just three seconds before liftoff. This was the fourth delay for Discovery, which was halted twice for technical problems in July and rescheduled because of a meteor shower on August 11. NASA said the next try could come in three to six weeks.

The cause of the problem was not identified, although space officials suspected that a fuel sensor might have fed wrong information to the Shuttle's computers. It told that one of the three main engines was not receiving fuel, the computers would trigger an automatic shutdown. (RTW Aug 12/93; AP, Aug 13/93; *W Times*, Aug 13/93; *USA Today*, Aug 13/93; *WSJ*, Aug 13/93; UPI, Aug 12/93; *NY Times*, Aug 13/93; *B Sun*, Aug 13/93; *W Post*, Aug 13/93)

- Eleven high school students participated in an eight-week Summer High School Apprenticeship Research Program (SHARP) at NASA's Dryden Space Center this summer. Four days a week, the participants completed a regular eight-hour workday, working alongside engineers and others, learning firsthand what it takes to succeed in these careers. The fifth day was spent in career exploration, perhaps a tour of different facilities at Edwards AFB or a visit to a university such as UCLA. (*Antelope Valley Press*, Aug 12/93)

August 13: NASA announced that it had tested helicopter rotor performance in icing conditions. The tests were performed in the Icing Research Tunnel at NASA's Lewis Research Center, Cleveland, Ohio. The new experimental database resulting from these tests was to be used to further refine and validate a computer code that predicts helicopter rotor performance loss occurring when ice accumulates on the rotors during an icing encounter. (NASA Release 93-147)

August 14: Under its High-Speed Research Program (HSRP), which began in 1990, NASA was doing basic research on developing a "clean" supersonic airliner, including preliminary studies of the potential of new materials. As part of this work, NASA was studying the atmospheric effects of supersonic aircraft in the stratosphere. The third report from this study, still in draft form and unlikely to be published in 1993, promised to dampen the optimism of previous research. (*New Scientist*, Aug 14/93)

August 15: Technical breakthroughs in space have helped launch clinical advances on Earth. Space Shuttle experiments, which focus on determining

how best to maintain the health of astronauts aboard a future Space Station, continue to provide spin-offs for clinical medicine on Earth, from programmable pacemakers to a better understanding of vestibular disorders. The cost, however, is very high, and the question remains whether the Space Station project represents a potentially giant leap for medicine or a small step for a select few. (*Medical World News*, Aug 15/93)

August 16: NASA's Jet Propulsion Laboratory (JPL), Pasadena, California, announced the selection of two major aerospace companies as the associate contractors for the Mars Environmental Survey (MESUR) Network Phase B1 study and MESUIR Pathfinder support effort. The companies were Hughes Aircraft Company; Hughes Spacecraft & Communications, El Segundo, California; and Rockwell International Corporation, Space Systems Division, Downey, California. (NASA Release C93-r)

August 17: NASA announced that the Johnson Space Center (JSC) in Houston, Texas, had awarded the Space Shuttle Orbiter Avionics Software contract to IBM Corporation, Houston. The contract was for the development and maintenance of the primary avionics support software, tool development and maintenance, and certification of primary flight software. (NASA Release C93-s)

- The Delta Clipper-Experimental (DC-X) rocket's first flight was scheduled for August 18 at White Sands Missile Range in Southern New Mexico. The 42-foot-tall, bullet-shaped DC-X is a one-third scale prototype of single-stage, reusable rocket that would be light enough to reach orbit and return without needing expensive lower stages or boosters that get thrown away on every flight. It would fire its engines to land vertically. The DC-X was developed by McDonnell Douglas with funding by the Federal Ballistic Missile Defense Organization. (AP, Aug 17/93)

- NASA Administrator Daniel S. Goldin announced that the Johnson Space Center, Houston, had been selected as the host center for the new Space Station program, replacing the center at Reston, Virginia. About 220 NASA workers in Reston would be reassigned or offered incentives to retire, the Space Agency said. Local Virginia lawmakers said that they would continue to fight NASA's decision to move the headquarters to Houston. The Boeing Defense and Space Group, based in the Seattle area, was selected as the prime contractor. (NASA Release 93-148; *H Post*, Aug 17/93; *W Times*, Aug 18/93; *NY Times*, Aug 18/93, Aug 19/93; *LA Times*, Aug 18/93, Aug 19/93; *WSJ*, Aug 18/93; *USA Today*, Aug 18/93; *W Post*, Aug 18/93; *RTW*, Aug 17/93; *AP*, Aug 17/93; *UPI*, Aug 18/93; *H Post*, Aug 19/93; *Space News*, Sept 13-19/93)

- The *New York Times* reported that a radio telescope spread across 5,000 miles had been finished. The new telescope, called the Very Long Baseline

Array (VLBA), has 10 antennas scattered across United States territory from the central Pacific Ocean to the Caribbean. All 10 antennas are very well synchronized as a single telescope of gigantic size, an arrangement that gives the VLBA far sharper vision than that of any other telescope. The telescope's revolving power is such that an observer in New York City would be able to read a newspaper in San Francisco. The VLBA was to be used to probe the depths of time and space. (*NY Times*, Aug 17/93)

August 18: Officials at the White Sands Missile Range in New Mexico announced that the Delta Clipper-Experimental rocket had successfully completed its first test flight, boosting backers' hopes that the single-stage design would be cheaper and more reliable than current space launch rockets. During the test flight, which lasted only about a minute, the rocket hovered briefly, flew about 350 feet to one side, and then touched down vertically on a landing pad. It was the first time a spacecraft had landed vertically on Earth. A second test flight was tentatively set for Aug. 27. In that test, the rocket was scheduled to go up about 650 feet. (*AP*, Aug 18/93; *WSJ*, Aug 19/93; *H Chron*, Aug 19/93; *H Post*, Aug 19/93; *W Times*, Aug 21/93; *Time*, Aug 30/93)

- NASA began replacing Space Shuttle Discovery's main engines in preparation for another launch attempt next month. The third countdown for Discovery ended on August 12 with an engine shutdown three seconds before launch. Engineers traced the problem to a sensor that was supposed to monitor the flow of fuel in Main Engine No. 2. (*AP*, Aug 18/93)

- Late this month, the Jupiter-bound Galileo spacecraft was scheduled to visit a big chunk of rock named Ida, only the second asteroid to be explored up close. Galileo, launched from a Space Shuttle in 1989, was scheduled to be within 1,500 miles of Ida in late August, on its way to its 1995 rendezvous with Jupiter. Galileo made the world's first asteroid encounter—with Gaspra—in October 1991.

The mission was successfully carried out on August 28, when Galileo photographed the asteroid from a distance of 1,500 miles. The resulting mosaic of five photographs shows a narrow object 32 miles long, riddled with pockmarks. (NASA Release 93-149; *AP*, Aug 18/93; *B Sun*, Aug 19/93; *NY Times*, Aug 22/93, Sept 28/93)

- Several articles in the media discussed the planet Mars. An article in the *Christian Science Monitor* discussed Mars exploration, noting that the arrival of the Mars Observer spacecraft on Mars was just the beginning of a new saga of planetary exploration. *U.S News and World Report*, in a cover story on Mars, suggested that exploration of the red planet would usher in a new space age; the article mentioned the upcoming missions to Mars, for example the NASA Mars Observer spacecraft, and then went on to identify key questions about Mars that explorations hoped to resolve. These questions concerned whether

or not Mars has water, what the weather is like, and what gave Mars its shape. The article also discussed where scientists are headed in their explorations of this planet. (CSM, Aug 18/93; *U.S. News and World Report*, Aug 23/93)

August 19: Mars Observer was scheduled to zoom into orbit around Mars next week, as the United States returned to Martian skies for the first time in 17 years. Mars Observer, which was launched from Florida on September 25, was scheduled to reach Mars on August 24. After maneuvering a near-polar orbit, it was scheduled to turn on its instruments and make one complete photographic map of the planet during a month-long test. It was scheduled to formally start its exploration on December 16. (*P Inq*, Aug 19/93)

August 23: NASA said that satellite controllers had lost contact with the NOAA-13 satellite on August 21, and preliminary indications were that the spacecraft's power system was not working. NOAA was the newest in a series of polar-orbiting weather satellites. Designed to monitor the Earth's ocean and atmosphere, it collects meteorological and ocean data for direct transmission to users around the world and to central data processing centers. (NASA Release 93-151)

- The 1993-94 season of NASA's Update for Teachers telecasts was scheduled to feature presentations on astronomy, life sciences, research, high-speed aeronautical research, and the environment and global change. The telecasts, a series of four, one-hour, live and interactive education television programs, were broadcast via satellite to schools in all 50 states, Canada, Mexico, and Puerto Rico between 3-4 p.m. Eastern Time. (NASA Release 93-150)

- Three days before the Mars Observer spacecraft was scheduled to begin orbiting the red planet, NASA engineers lost communications with the \$1 billion probe. Radio contact broke off after engineers commanded the spacecraft to prepare for a crucial rocket firing on August 24 that was designed to send the spacecraft in orbit around the planet. Mars Observer was programmed to automatically fire its rockets, but NASA needed to hear from the spacecraft to be certain that had happened. If the commands were not received, the ship could fly past Mars completely. NASA officials expressed grave concern over the problem but said that communications could be restored at any moment. (UPI, Aug 22/93; AP/Aug 23/93; RTW, Aug 23/93; WSJ, Aug 23/93; *P Inq*, Aug 23/93; *B Sun*, Aug 23/93; *USA Today*, Aug 23/93; *W Post*, Aug 23/93; *NY Times*, Aug 23/93; *C Trib*, Aug 23/93; *LA Times*, Aug 23/93; RT, Aug 23/93)

- Vigyan Corporation, Hampton, Virginia, last week asked the General Services Administration's Board of Contract Appeals to overturn what was thought to be the largest minority-set-aside contract ever, a \$180 million pact with Nyma Corporation, Greenbelt, Maryland, for engineering support services at NASA's Lewis Research Center. Vigyan specifically charged both Nyma and NASA with conflict of interest, saying the company's winning proposal listed a cur-

rent NASA employee “who possesses both proprietary and source-selection information” relevant to Vigyan’s bid. (*Federal Computing Week*, Aug 23/93)

August 24: NASA officials said that the Mars Observer mission could be a total loss if ground controllers failed to reestablish contact with the probe in time for the scheduled start of the orbit on August 24. Engineers suspected that a faulty flight clock aboard the craft might have caused communications to cease. New computer commands were sent telling Mars Observer to switch to a backup clock. However, the commands failed to restore contact with the spacecraft, suggesting that the clock theory was wrong. If contact could not be restarted, controllers would have no way of receiving scientific data or even confirming if the Mars Observer probe had made it into orbit. The Mars Observer project was the first U.S. mission to Mars in 17 years; it was designed to pave the way for a new generation of international planetary exploration centered on Mars.

The prognosis was even worse for a \$67 million weather satellite launched for NASA by the Air Force from California on August 9. Officials said today that they were 90 percent certain that an electrical malfunction had killed the satellite, called NOAA-13. (AP, Aug 24/93; RT, Aug 24/93; *USA Today*, Aug 24/93, Aug 25/93; *NY Times*, Aug 24/93, Aug 25/93; *P Inq*, Aug 24/93, Aug 26/93; *LA Times*, Aug 24/93, Aug 25/93; *W Times*, Aug 25/93; *WSJ*, Aug 25/93; *W Post*, Aug 25/93; *B Sun*, Aug 25/93; RTW, Aug 25/93; UPn, Aug 24/93; *C Trib*, Aug 24/93)

- Some scientists, led by former CBS News science adviser Richard C. Hoagland, accused NASA of not doing enough to investigate surface features that may be signs of intelligent life. The critics say that computer-enhanced photographs taken by the 1976 Viking Mars mission show objects on the Cydonia Plain that they believe were left by an extraterrestrial civilization. Mr. Hoagland said a “rogue group in NASA” might have sabotaged the Mars Observer mission to suppress information about the Cydonia Plain structures. NASA officials denied the charge. (APn, Aug 24/93; *LA Times*, August 25/93; *Weekly World*, Sept 14/93)

August 25: NASA announced that it would fund three new university research centers charged with fostering the next generation of researchers and engineers in hypersonic aeronautics—flight at more than five times the speed of sound. Scheduled to receive \$200,000 annually for three years were Syracuse University, New York; the University of Maryland, College Park; and the University of Texas at Arlington. (NASA Release 93-152)

- A study by James W. Elkins of the National Oceanic and Atmospheric Administration found that worldwide emissions of the two worst ozone-destroying chemicals were slowing sooner than researchers had expected, and the gradual repair of Earth’s ozone layer could begin by 2000. This news came as NASA satellite data indicated that the stratospheric ozone layer that shields the Earth from cancer-causing ultraviolet radiation had dropped to its lowest levels ever. A NASA official said that even with the peak in emissions of chlorofluorocarbons by 2000, it would take about a century for the ozone layer to recover to

what it was before ozone-destroying chemicals began to be widely used in the 1960s and 1970s. (AP, Aug 25/93; *USA Today*, Aug 26/93; *W Post*, Aug 26/93; *NY Times*, Aug 30/93)

August 26: NASA Administrator Daniel S. Goldin named Dr. Timothy Coffey, director of research at the Naval Research Laboratory, Washington, DC, to head the review board to investigate the loss of contact with the Mars Observer spacecraft. (NASA Release 93-153)

- NASA announced that a 12-member panel of experts from NASA and NOAA had been named to investigate the failure of the NOAA-13 meteorological satellite. (NASA Release 93-154)

- The Mars Observer failed to call Earth on August 25, when a five-day timer should have had it send an emergency signal, lessening hopes that the mission could be salvaged. Observer was the latest reminder of the growing problems of the U.S. space program. The Observer failure added to a string of expensive space failures: the loss earlier in August of a \$500-million spy satellite, then of a \$67-million weather satellite, and a series of mishaps with NASA's orbiting observatories and other planetary probes.

In Washington, congressional strategies and private analysts suggested that NASA's latest failure was likely to make the Agency more vulnerable to budget cuts as Congress considered the appropriations bill covering the space program. Ideas also were floated about new, cheaper ways to get a peek at Mars, for example, modifying small, inexpensive "Star Wars" satellites and hurling them toward Mars. Another idea mentioned was closer collaboration with Europe and Russia. (*LA Times*, Aug 25/93; *WSJ*, Aug 26/93, Aug 30/93; *USA Today*, Aug 26/93, Aug 30/93; *W Post*, Aug 26/93; *W Times*; AP, Aug 26/93; RTW, Aug 25/93; UPI, Aug 25/93; *NY Times*, Aug 29/93)

- Orbital Sciences Corporation of Chantilly, Virginia unveiled the Orbcomm communications satellite, which was designed to provide global personal communications service. The company said it planned to initiate Orbcomm service in the United States by mid-1994 and planned worldwide service by 1995. The Orbcomm system planned to provide low-cost, two-way data communications to users worldwide through a constellation of 26 small satellites. (*W Times*, Aug 26/93)

- A senior NASA official who asked not to be named said that the Agency was seriously considering attaching Space Station Freedom modules to Russia's Mir Space Station and helping to refurbish the seven-year-old facility. NASA was also actively looking at combining Freedom with the next-generation Mir Station, which Moscow said it planned to launch around 1996. (*Defense Daily*, Aug 26/93)

August 27: NASA announced that Kennedy Space Center Director Robert Crippen and Florida Governor Lawton Chiles had signed an agreement that would transfer benefits derived from the U.S. space program to the private sector and industries in Florida. The two parties agreed to set aside \$1 million each for the next two years to implement projects under this agreement. (NASA Release 93-155)

August 28: NASA announced that the Galileo spacecraft had successfully explored the asteroid Ida located between Mars and Jupiter. Although hampered by a jammed main antenna, Galileo zoomed around 1,491 miles from Ida and took all but three of 21 planned photographs. The three missing photos were the longest-distance photos and unimportant compared with the close-ups. The first photos were not scheduled to arrive at Earth for another two months; the others were to be transmitted in the spring of 1994. (AP, Aug 28/93; RTW, Aug 28/93; *USA Today*, Aug 30/93; *NY Times*, Aug 29/93)

August 29: Russian Prime Minister Viktor Chernomyrdin said that Russia would start selling foreign countries space technology without the machinery to launch nuclear missiles. Chernomyrdin spoke before leaving Moscow for an official visit to the United States that had been set for June but cancelled after a dispute with Washington over rocket technology sales to India.

Chernomyrdin began his U.S. trip in Houston, where his visit was to center on meetings Monday with U.S. business from the energy and aerospace industries and was to include a tour of the Johnson Space Center (RTW, Aug 29/93)

- The failure of the Mars Observer mission led to a debate over the need for big, costly space projects. Commenting on the loss of the Mars Observer, an editorial in the *Christian Science Monitor* advocated moving away from complex missions that take a decade or more to launch in favor of cheaper, simple spacecraft. In this regard, the editorial suggested that NASA Administrator Daniel S. Goldin and the Clinton administration reconsider the Space Station program, which, in the editorial writer's view, robs NASA of the money needed for a broad effective space program.

Writing in the *Baltimore Sun*, Robert L. Park, professor of physics at the University of Maryland, College Park, expressed similar views. He traced NASA's current problems to the Agency's abandoning of all existing launch systems for the expensive manned Space Shuttle. Parks emphasized that a replacement must be developed for the Shuttle, that the excessive emphasis on human space flight must end, that the bureaucracy that is choking NASA must be streamlined, and that the old spirit of elan that once permeated the Agency must be restored.

Doug Bandow, a senior fellow at the Cato Institute, also argued that the space program should be cut back. He noted that while NASA's recent failures were unfortunate, they would have a positive effect if they forced lawmakers to reconsider the justification for the multi-billion-dollar space program. He said that U.S. budget priorities should lie much closer to home. Writing in support of the Space Station was ex-astronaut Alan Shepard, the first American to travel in space and the commander of the Apollo mission to the Moon.

A commentary in the *Philadelphia Inquirer* outlined the issues involved in the debate over big missions versus small missions, while a commentary in

Time magazine suggested that NASA “learn the fine art of lowering expectations.” *B Sun*, Aug 29/93; *CSM*, Aug 32/93; *W Times*, Sept 1/93; *P Inq*, Sept 2/93; *Time*, Sept 6/93; *W Times*, Sept 15/93)

August 30: Astronauts assigned to the Space Shuttle Columbia mission in the fall of 1993 were scheduled to conduct experiments on rats while in orbit. After beheading the rats, they were to dissect them. This would be the first dissection of an animal in space, to NASA’s knowledge. The remaining rats aboard the Shuttle were scheduled for a similar fate once they returned to Earth. NASA’s Willy Hinds, a biologist and immunologist who is in charge of the project, said that “these tissues... are the biological equivalent of the Moon rocks.” (*AP*, Aug 30/93; *LA Times*, Sept 5/93)

- Scientists failed in a new attempt to get the Mars Observer spacecraft to re-establish contact with Earth, NASA’s Jet Propulsion Laboratory said. The spacecraft did not respond to commands to turn on its primary telecommunications equipment. A proposal to try to restart the Observer’s central computer was rejected because it was thought to pose an unnecessary risk to telecommunications with other spacecraft. (*RTW*, Aug 30/93; *W Post*, Aug 31/93; *AP*, Aug 31/93; *CSM*, Sept 1/93)

- The European Space Agency, eager to boost its cooperation with Russia, said that it was studying the joint development of a new generation of space vehicles. Jean-Jacques Dorian, director of policy planning, told journalists on the eve of Moscow’s first aerospace show that the agency had contracts worth millions of dollars with a number of Russian firms. (*RTW*, Aug 30/93)

August 31: Orbital Sciences Corporation said its Orbital Imaging Corporation unit had been awarded a two-year, \$7 million contract to provide atmospheric research data to NASA’s Marshall Space Flight Center. (*W Times*, August 31/93)

- People with temperature disorders have benefitted from suits developed by NASA for use by astronauts in very hot temperatures. The suits have been modified for people who need help in keeping their body temperature down in hot weather. The suits for children are vests stuffed with detachable “cold packs,” much like those used to keep food cold in picnic coolers. Other suits are powered by battery packs and fitted with tubes that circulate coolant. The suits are made of a material known as Thinsulate. (*Fairfax County Journal*, Aug 31/93)

- Moscow held its first international aerospace show in Moscow. As many as 200 foreign aerospace companies and 250 enterprises from all over the former Soviet Union took part in the show, the largest event of its kind ever held in Russia. Russian military space equipment was on show for the first time. (*UPI*, Aug 31/93; *LA Times*, Sept 1/93)

September

September 1: NASA Administrator Daniel S. Goldin announced the establishment of a study team at NASA's Jet Propulsion Laboratory, Pasadena, California, to explore possibilities for a return mission to Mars to recover some of the scientific objectives of the Mars Observer mission, if communications with that spacecraft could not be reestablished. (NASA Release 93-157; UPI, Sep 1/93; AP, Sep 1/93)

- Rocketdyne, the Canoga Park unit of Rockwell International, was blamed for the last-minute blastoff delay of Space Shuttle Discovery. The shutdown was traced to a faulty fuel sensor in one of Discovery's engines, built by Rocketdyne. This was not the first time that Rocketdyne had been blamed for a day. The company makes the Shuttle's main engines, which in 1993 caused two last-minute aborted launches. They have also caused at least two more launch delays involving the Columbia and Endeavour Space Shuttles. (*LA Times*, Sep 1/93)

September 2: Vice President Gore and Russian Prime Minister Chernomyrdin signed an agreement to embark on a joint effort to design and construct an international Space Station. In a separate agreement, Russia also agreed to place export controls on missile technology, a precondition set by the Clinton administration to cooperation in space. Russia also gained access to the lucrative international market for launching commercial satellites. (NASA Release 93-158; UPI, Sep 2/93; AP, Sep 3/93; *NY Times*, Sep 3/93; *P Inq*, Sep 3/93); *WSJ*, Sep 3/93; *LA Times*, Sep 3/93; *W Post*, Sep 3/93; *W Times*, Sep 3/93; *RTW*, Sep 3/93; *B Sun*, Sep 5/93; *CSM*, Sep 14/93; *National Journal*, Sep 11/93)

September 3: Richard H. Kohrs, director, Space Station Freedom, retired from NASA after 30 years of service. Kohrs was appointed Space Station Freedom director on June 1, 1989. (NASA Release 93-160)

- NASA announced a ceremonial ground-breaking for two NASA projects at the Wheeling Jesuit College, Wheeling, West Virginia: the Classroom of the Future and the National Technology Transfer Center (NTTC).

The Classroom of the Future is a leading-edge, educational technology initiative to improve the quality of science, mathematics, and technology education nationwide. It is a laboratory to develop stimulating, interactive multimedia curriculum materials and model preservice and in-service teacher education programs. The NTTC operates a national gateway service that assists U.S. firms in rapidly locating Federal laboratory technology and provides the associated technology transfer assistance. (NASA Release 93-158)

- Martin Marietta Corporation, which in one three-week period in August, saw one of its rockets explode soon after launch and two of its satellites lose contact with Earth, announced on September 3 that it was undertaking an internal investigation of all phases of its space division. (*W Post*, Sep 4/93)

September 7: NASA reportedly was taking action to rectify the problems that had beset recent space missions. Led by Administrator Daniel S. Goldin, NASA was itself doing more rigorous quality testing, adopting Total Quality Management, and making contractors financially liable for shoddy work. (*USA Today*, Sep 7/93; *B Sun*, Sep 5/93)

- Using the Hubble Space Telescope, astronomers have been able to see a double star whose existence they had known only by the intermittent bursts of x-rays recorded over the last 20 years. The binary star, made up of a neutron star and a white dwarf, is 30,000 light-years away from Earth. The report of the discovery was recently published in *Astrophysical Journal Letters*. (*NY Times*, Sep 7/93; *W Times*, Sep 5/93; *W Post*, Sep 13/93).

- Christa McAuliffe, the teacher-astronaut who was killed when the Space Shuttle Challenger blew up, is the subject of a new biography, written by her mother, Grace George Corrigan. The biography, *A Journal for Christa*, published on September 7, by the University of Nebraska Press, lends weight to arguments that NASA pressed ahead with the high-profile flight to win mention of it in President Reagan's State of the Union message, which had been scheduled for January 28, the day of the launch. (*AP*, Sep 7/93; *NY Times*, Sep 8/93; *B Sun*, Sep 8/93)

September 8: NASA selected USN Commander James D. Wetherbee to command the STS-63 mission aboard Shuttle Discovery in mid-1994. Other crew members picked were Major Eileen M. Collins, pilot; C. Michael Foale; Janice E. Voss; Bernard A. Harris, Jr.; and Russian Air Force Colonel Vladimir G. Titov. Collins is the agency's first woman pilot.

- NASA announced that Shuttle Discovery was to conduct an unprecedented fly-around maneuver of the Russian Mir Space Station in June. Although the operation was not to include a docking of the two spacecrafts, it would help to establish the rendezvous procedures for a docking mission planned for June 1995. (NASA Release 93-161; *H Chron*, Sep 9/83)

September 9: NASA settled a union grievance with Reston, Virginia, Space Station employees and cleared the way toward opening a new office in Houston, Texas. (*H Post*, Sep 9/93)

- Space Station backers reportedly were worried about uncertainties about Russia's role in the proposed new Station. Senator Barbara A. Mikulski, D-

Maryland, who chairs the Senate appropriations subcommittee that funds NASA, said, "We support a cooperative effort with Russia, but we believe the Space Station effort, if approved by Congress, must be an American Space Station."

NASA presented the latest in a series of redesigns and downsizing of the Space Station to President Clinton on September 7. The plan envisions attaching two Soyuz ships to the Station as "assured crew return vehicles." It also spoke favorably of using the Russian Salyut space tug for steering the Station, instead of a propulsion module developed by the Pentagon. (*W Post*, Sep 9/93; *AP*, Sep 9/93, Sep 22/93; *CSM*, Sep 10/93; *AvWk*, Sep 13/93; *LA Times*, Sep 16/93)

September 10: NASA Administrator Daniel S. Goldin announced that Dr. France Anne Cordova, head of the astronomy and astrophysics department, Pennsylvania State University, was scheduled to assume the responsibilities of NASA Chief Scientist effective mid-October. She was to be on extended detail from the University to NASA. (NASA Release 93-162)

- The Senate Appropriations Committee approved \$1.9 billion for continued work on Space Station Freedom, but the project faced a fight in the full Senate, where opponents wanted to cut funding. (*USA Today*, Sep 10/93)

September 11: The Delta Clipper-Experimental, a 42-foot prototype for a new generation of reusable spacecraft, climbed to about 300 feet, hovered, moved laterally about 350 feet, then made a vertical landing at the White Sands Missile Range in New Mexico. This was the spacecraft's second successful test flight. (*B Sun*, Sep 12/93; *National Journal*, Oct 2/93)

September 12: Space Shuttle Discovery was launched on a satellite-deployment mission after two months of delays. The liftoff had been postponed five times for equipment failure, payload problems, and a meteor shower. After a short delay caused by a minor communications problem, astronauts on board successfully deployed the \$363 million Advanced Communication Technology Satellite (ACTS). The satellite could one day shrink the diameter of satellite dishes to one and one-half feet.

On September 14, after a ninety-minute delay caused by a communications problem, astronauts placed in space a second satellite, an \$80 million reusable craft made by Germany. The satellite, which had an ultraviolet telescope and a spectrograph to study interstellar gas, was scheduled to be retrieved by the astronauts in six days for the trip home. On September 16, two astronauts conducted a seven-hour spacewalk to test tools needed for the Hubble Space Telescope repair mission scheduled for December; and on September 19, using a 50-foot robot arm, they retrieved an orbiting German telescope loaded with nearly a week's worth of star observations. The retrieval of the satellite was the crew's last major job.

Discovery touched down at Cape Canaveral, Florida, on September 22, its return having been delayed one day because of bad weather. This was the first

Shuttle landing in Florida at night. (RTW, Sep 12/93, Sep 13/93, Sep 14/93, Sep 15/93, Sep 16/93, Sep 19/93; *P Inq*, Sep 13/93, Sep 14/93, Sep 17/93; *B Sun*, Sep 13/93, Sep 14/93, Sep 17/93; *NY Times*, Sep 13/93, Sep 16/93, Sep 17/93; *W Post*, Sep 13/93, Sep 14/93, 15/93, Sep 17/93, Sep 19/93, Sep 20/93; *USA Today*, Sep 13/93, Sep 14/93, Sep 20/93; AP, Sep 12, Sep 14/93, Sep 15/93, Sep 16, Sep 17/93, Sep 20, Sep 22/93; UPI, Sep 12/93 Sep 13/93, Sep 14/93, Sep 16/93, Sep 17/93, Sep 19/93, Sep 22/93; RTW, Sep 22/93; *W Post*, Sep 23/93)

September 13: Writing in *Business Week*, science writer John Carey predicted that Congress would ultimately keep alive the Space Station, which he labelled a boondoggle, and very likely kill the scientifically worthy Super Collider. Carey charged that the Space Station was mainly being kept alive to preserve 15,000 mostly high-paying jobs in areas hard hit by defense cut-backs. He viewed the cries of those who charged that the country couldn't afford the Super Collider as hypocrisy, noting that Congress funds much less worthy projects. (*Business Week*, Sept. 13/93)

September 14: NASA selected Recom Technologies, San Jose, California, a small disadvantaged business, for negotiations leading to award of a contract for Computational Administrative, Professional, and Engineering Services to support NASA's Lewis Research Center, Cleveland. (NASA Release C93-t)

September 17: A NASA SR-71 "Blackbird" research aircraft made the first triple-sonic flight test of a laser measurement system that could give pilots more accurate data on their air speed and aircraft attitude. (NASA Release 93-163)

- According to a USA Today/CNN/Gallop Poll, most Americans now feel the nation should cut or eliminate spending for the space program. Marcia Smith of the Congressional Research Service said that people are concerned about where to cut the budget, and NASA is seen as a discretionary program. The poll also revealed that people were losing faith in NASA's performance. (*USA Today*, Sep 7/93)

September 20: Two separate teams of astronomers reported finding what could be the first direct evidence of the existence of chunks of invisible matter that in theory form a massive, unseen halo around Earth's galaxy, the Milky Way.

If the finding stands up, it is a significant breakthrough in the search for so-called dark matter. A U.S.-Australian team announced the discovery simultaneously with a French team. (*W Post*, Sept. 21, *P Inq*, Sep 21/93; *NY Times*, 1993; UPn, Sep 21/93)

- Over the next two decades, NASA planned to launch more than two dozen satellites for its "Mission to Planet Earth." These satellites were scheduled to collect information about clouds, ocean circulation, and ice and pollution in order to help scientists refine their predictions of global warming. (*Newsweek*, Sep 20/93)

- Marshall Engineers and Scientists Association President Wesley Darbro said that it appeared that the Marshall Space Flight Center would lay off about 478 workers, all associated with the Space Station program. (*Huntsville Times*, Sep 20/93)

September 21: Air traffic controllers reported that their new \$839 million radar system has some serious flaws: planes vanish from screens, phantom images appear, and even a squirrel can chew up the network. NASA said that it has received many complaints at its Ames Research Center at Moffett Field, California, home of NASA's aviation safety reporting system. (AP, September 21/93)

- The Senate endorsed the Clinton administration's plan to build the Space Station by refusing to cut funding for the 1994 program from \$1.94 billion to \$500 million. The latter amount would have been used to shut down the program. (RTW, Sep 21/93; UPI, Sep 21/93; AP, June 22/93; *LA Times*, Sep 22/93; *P Inq*, Sep 22/93; *NY Times*, Sep 23/93)

September 22: New software, the New Spectral Imaging Processing System (NEWSIPS), was giving researchers a remarkably improved look at data from NASA's International Ultraviolet Explorer (IUE), the space agency's longest-running astronomical satellite in Earth orbit. (NASA Release 93-164)

September 23: NASA announced that researchers had recorded unexpected, huge flashes of light in the upper atmosphere that might affect atmospheric ozone and present potential problems for high-altitude research planes. The flashes occurred above a severe thunderstorm in the Midwest in the summer and were recorded aboard NASA's DC-8 Airborne Laboratory, based at Ames Research Center, Moffett Field, California. (NASA Release 93-167; *W Post*, Sep 24/93; AP, Sep 23/93)

- NASA announced that results from a Spacelab crystal growth experiment flown aboard the Space Shuttle last summer had brought researchers closer to understanding the molecular structure of proteins; such understanding would aid scientists in developing more effective disease-fighting, anti-parasitic drugs. (NASA Release 93-166)

- NASA announced that flight tests with a NASA research aircraft last week had demonstrated the first precision automatic approaches and landings using Differential Global Positioning System (DGPS) navigation satellite signals. The procedures were carried out without using complex processing techniques. (NASA Release 93-165)

September 24: NASA announced the selection of four candidate Small Explorer missions: the Joint Ultraviolet Night Sky Observer (JUNO), the Positron Electron Magnetic Spectrometer (POEMS), the Transitional Region

and Coronal Explorer (TRACE), and the Wide-Field Infrared Explorer (WIRE). The four proposed missions were scheduled to enter a ten-month definition phase. After that phase, NASA planned to confirm two missions for development and flight and to launch the confirmed missions in 1997 and 1998. (NASA Release 93-168).

- NASA officials announced that further testing on the Wide Field/Planetary Camera II (WF/PCII), an instrument scheduled to fly on the Hubble Space Telescope Servicing Mission in December, might be necessary. Tests had cleared the camera of suspicion that it was flawed, but NASA asked for one last independent review of the data just to make completely sure. (NASA Release 93-169; *W Post*, Sep 28/93)

September 27: Lt. Gen. James H. Doolittle, legendary Army aviator and World War II hero, died at the age of 96. He was best known for leading "Doolittle's Raiders" in a daring bombing run on Tokyo and other Japanese cities in April 1942. The raid brought the war home to Japan for the first time and lifted American morale when the country was still reeling from a string of Axis victories. After the war, General Doolittle served as president of the Institute of Space and Aeronautical Science and chairman of the National Advisory Committee for Aeronautics, the forerunner of NASA. (*B Sun*, Oct 1/93; *AP*, Oct 1/93; *W Post*, Oct 2/93)

September 28: Representatives from NASA, the Federal Aviation Administration (FAA), and industry described how they had worked together to take windshear advance-warning devices from the drawing board to the commercial aviation marketplace in just five years. The windshear reports, part of a NASA/FAA conference in Hampton, Virginia, detailed development of microwave radar, laser radar, and infrared sensors that provide up to 40 seconds warning of windshear. Now NASA and the FAA were considering whether pilots should have formal training to interact with these new instruments. (NASA Release 93-270 and 93-171; *AvWk*, Oct. 18/93)

- The Spacelab Life Sciences-2 (SLS-2) mission scheduled for October would offer scientists unprecedented opportunities to learn more about how life adapts to the microgravity environment of space flight. For the first time in the history of space flight, scientists were to collect tissues during the mission. Crew members were to draw blood samples from both themselves and rats and were to dissect five rats in space. (NASA Release 93-173)

September 30: NASA and the Federal Aviation Administration (FAA) described innovative new aeronautics research programs that would let airports across the nation and around the world handle more planes with fewer delays while maintaining today's high level of safety. (NASA Release 93-172)

- NASA's Hubble's Space Telescope's picture of Nova Cygni 1992 gave astronomers their earliest look at a rapidly ballooning bubble of gas blasted off a star. Nova Cygni 1992 erupted on February 19, 1992. (NASA Release 93-174)
- The Senate voted to continue funding the multibillion-dollar Superconducting Super Collider project, which the House had voted to eliminate. The issue now goes to a House-Senate conference as part of a \$22.5 billion spending bill for fiscal 1994 energy and water projects. (UPI, Sep 30/93; *W Post*, Oct 1/93; *NY Times*, Oct 1/93)

During September: A University of New Hampshire-NASA study revealed that tropical deforestation and adverse effects on tropical forest habitat have increased in the Brazilian Amazon Basin since the late 1970s. Data from the Landsat-4 and -5 satellites covering 1978-88 indicated that although the extent of deforestation was less than expected, deforestation had increased substantially and created adverse "edge-effects" that posed a substantial threat to the habitat of plant and animal species. (*El Mundo Latino*, Sep/93)

- Commentaries appeared in the press both supporting and opposing funding for the Superconducting Super Collider. Supporters of the project noted that the Super Collider involved basic scientific research that would benefit society in countless ways. Critics, admitting that the Super Collider might well advance science, argued that the cost of continuing the program was too high in the current budgetary climate. (*LA Times*, Sep 24/93; *USA Today*, Sep 28/93; *W Post*, Sep 29/93)

October

October 1: House-Senate conferees killed NASA's program to search for signs of intelligent civilization beyond Earth and reduced funding available for a reflight of the agency's lost Mars Observer mission. In approving a total agency budget of \$14.5 billion, the legislators barely preserved a program to build a more powerful rocket booster for the Space Shuttle and provided very little funding for developing new technology needed for the National AeroSpace Plane. The planned Space Station was fully funded at \$2.1 billion for fiscal 1994. (*W Post*, Oct. 2/93; AP Oct 2/93)

October 4: NASA announced that NASA scientists were to spend October and November in Antarctica testing "telepresence technology" that might be used in the future to explore Mars. The research expedition was sponsored by a joint NASA-National Science Foundation Antarctic Space Analog Program and funded for NASA by the Offices of Space Science and Advanced Concepts and Technology. (NASA Release 93-178; *LA Times*, Oct 3/93; UPI, Oct 4/93)

- Hughes Aircraft and Perkin-Elmer Corporation agreed to pay \$25 million to head off a threatened government lawsuit, charging them with liability for the defect that crippled the \$2-billion Hubble Space Telescope, the Justice Department announced. (UPI, Oct 4/93; AP, Oct 5/93; *NY Times*, Oct 5/93; *B Sun*, Oct 5/93, Oct 8/93; *W Post*, Oct 5/93; *WSJ*, Oct 5/93; *LA Times*, Oct 5/93)

- NASA Administrator Daniel S. Goldin announced the recipients of the Minority Contractor and Subcontractor of the Year Awards in recognition of minority businesses that had made outstanding contributions to NASA. Hernandez Engineering, Inc., Houston, was named as Minority Contractor of the Year. AJT and Associates, Inc., Cape Canaveral, Florida, was named Minority Subcontractor of the Year. (NASA Release 93-177)

- NASA's Compton Gamma-Ray Observatory was to receive a scheduled boost to a higher orbit beginning on October 4, to prevent the spacecraft from reentering the Earth's atmosphere. The reboost was necessary to compensate for orbit decay, which is the result of solar activity slowly pushing the satellite toward Earth over a period of time, said NASA officials. (NASA Release 93-179)

October 5: A conference committee of the Senate and House eliminated \$12.3 million earmarked for the Search for Extraterrestrial Intelligence (SETI) project. Angry astronomers began seeking private funds to continue their work, which had been underway for barely a year. (*SF Chron*, Oct 6/93; *NY Times*, Oct 7/93; *San Francisco Examiner*, Oct 4/93)

October 6: A \$220 million Landsat 6 Earth Observation satellite was launched into the wrong orbit, and ground controllers were unable to make contact with the satellite, according to a mission spokeswoman for Earth Observation Satellite Company (ESAT). The satellite was supposed to go into orbit over the poles during a five-year mission studying the Earth's environment. An ESAT official said that the company hoped to get the satellite into the proper orbit by the end of the week. (*W Post*, Oct 6/93; *USA Today*, AP, Oct 6/93)

- NASA's inspector general told Congress that NASA is plagued with contractors who overcharge, receive bonus payments while running up huge cost overruns and employ workers who frequently sleep on the job. The agency currently has more than 400 criminal fraud investigations under way, the inspector general told the House Government Operations Committee. (AP, Oct 6/93; *NY Times*, Oct 6/93, Oct 7/93; *LA Times*, Oct 7/93)

October 7: U.S. space pioneer William H. Pickering was the first recipient of the \$250,000 Francois-Xavier Bagnoud Aerospace Prize, the largest of its kind. As director of the Jet Propulsion Laboratory in California, Pickering prepared the first U.S. satellite, Explorer 1, for launch in just 83 days following the launch of the Soviet Sputnik 1 in 1957. (*W Post*, Oct 7/93)

- NASA reported that an explosive designed to free a satellite aboard Space Shuttle Discovery accidentally detonated while the Shuttle was in orbit last month, hurling shrapnel through the cargo compartment. The five astronauts were never in any danger, a NASA official said. The damage would not delay Discovery's next flight in January. (RTW, Oct 7/93; AP, Oct 8/93; *Fla Today*, Oct 11/93, Oct 14/93)

October 8: A recent Space Shuttle experiment on rats may lead some day to the discovery of the genes that direct bone cells to produce more bone. The third Physiological and Anatomical Rodent Experiment (PARE-3) studied changes in the activity of bone-forming cells after nine days of space flight. It also investigated whether these changes were reversed within three days of return to Earth. (NASA Release 93-181)

October 12: NASA scientists were scheduled to test an "intelligent" computer on the 14-day Spacelab life sciences mission, scheduled for launch in early October. The computer, known as the Astronaut Science Advisor, was designed to help astronauts work more efficiently and improve the quality of science in space. (NASA Release 93-180)

- In the current issue of the journal *Science*, astronomers reported that refined analysis of spacecraft data had led them to estimate that the heliopause is somewhere from 116 to 177 times farther away from the Sun than is Earth.

The previous calculations, announced in May, gave a lower estimate of 82 to 130 times. (*NY Times*, Oct 12/93)

- NASA officials said that its Compton Gamma-Ray Observatory had yielded three major breakthroughs, two of which would enable scientists to unmask hidden supernovae buried deep in the center of the Milky Way. The third discovery pinpoints a source of the mysterious cosmic rays in this galaxy that have puzzled researchers since the rays first were detected more than 80 years ago. (NASA Release 93-182)

- NASA announced that it had received a request from Russian physicians treating victims of the recent emergency in Moscow for medical assistance from U.S. clinicians. The medical consultations were to use a previously established U.S./Russian satellite telemedicine program known as "Spacebridge to Moscow." NASA first became involved in satellite telemedicine programs in the 1970s when a NASA satellite was used for medical consultation and health care delivery to remote sites in Alaska. (NASA Release 93-183)

October 13: NASA announced the formation of an investigation board to examine the causes of a simultaneous detonation of two Super Zip explosive cords, one primary and the other a backup, that occurred during the deployment of the Advanced Communications Technology Satellite (ACTS) and its Transfer Orbit State (TOS) booster from Discovery during Shuttle mission STS-51 (September 12-20, 1993). (NASA Release 93-184)

- NASA's Johnson Space Center, Houston, Texas, selected Lockheed Engineering and Sciences Corporation, Houston, for the Engineering, Test, and Analysis contract worth \$12.5 billion over 10 years, beginning January 1, 1994. (NASA Release C93-y)

- Miles "Mike" Ross, former deputy director of the Kennedy Space Center, died of cancer Wednesday at his home. He was 74. Mr. Ross joined NASA in 1967 as deputy director of the center's engineering and technical operations. He became deputy center director in 1970. (*Fl Today*, Oct 15/93)

October 14: A last-minute glitch in a computer system that monitors Shuttle takeoffs to ensure people's safety on the ground forced NASA to scrub the launch of Shuttle Columbia on a medical research mission. NASA said that it would try for an October 15 launch, if the weather cooperated.

A small group of animal rights protesters carried signs at Gate 2 of the Kennedy Space Center on the day of the expected launch; they objected to the use of rats in experiments aboard the Columbia. (*AP*, Oct 14/93; *UPI*, Oct 14/93; *NY Times*, Oct 14/93, Oct 15/93; *B Sun*, Oct 15/93; *W Post*, Oct 15/93; *P Inq*, Oct 14/93, Oct 15/93; *Fl Today*, Oct 15/93; *O Sen Star*, Oct 15/93; *USA Today*, Oct 14/93)

October 15: Scientists at NASA's Ames Research Center, Moffett Field, California, and the Joint Astronomy Centre, Hilo, Hawaii, discovered an unexpected type of molecule in the ices of a star-forming cloud. The scientists have detected large amounts of molecular hydrogen frozen into the ice grains in a dense molecular cloud in Rho Ophiuchus. Rho Ophiuchus is known as a stellar nursery, a region in the Milky Way Galaxy where new stars are being formed. (NASA Release 93-187)

- NASA announced that the IC2 Institute, Austin, Texas, had appointed John S. Gee as the director of the Ames Technology Commercialization Center (ATCC) located in Sunnyvale, California. The IC2 Institute, a unit of the University of Texas, was contracted by NASA's Office of Advanced Concepts Technology, Washington, DC, to assist NASA Centers in the transfer of technology to the private sector. (NASA Release 93-185)

- The NASA Office of Advanced Concepts and Technology selected 52 proposals for negotiations leading to Phase A awards to develop flight experiments in response to the 1992 In-Space Technology Experiments Program (IN-TEP) Announcement of Opportunity. For the 1992 program, proposals were solicited in eight different technology areas: space communications; cryo fluid handling; human support; in-space construction, repair, and maintenance; space materials, coatings, and environmental effects; space power, science sensor, and sensor cooling; and vibration isolation. (NASA Release 93-186)

- NASA Administrator Daniel S. Goldin told Congress that the United States could save \$3.5 billion by building the Space Station with the Russians. He also testified that a joint Space Station could be finished and inhabited by U.S. astronauts by April 2001, two years earlier than without Russian cooperation. (*WSJ*, Oct 15/93; *Huntsville Times*, Oct 15/93)

- A report by the General Accounting Office found that for years NASA had disregarded or misunderstood property regulations. Under Federal regulations, contractors doing business with the government must provide their own equipment unless their reasons are approved by the agency signing the contract. NASA, however, rarely applied these tough regulations to its contractors, so that businesses have billions of dollars of taxpayer-purchased property. (*Fla Today*, Oct 15/93, Oct 18/93)

October 16: Two Russian cosmonauts orbiting the Earth since July have been forced to extend their stay on the Mir Space Station by 49 days because of a delay in sending a relief craft, a space agency official announced. (RTW, Oct 16/93)

October 18: NASA officials announced that the Hubble Space Telescope had provided the most detailed look yet at Comet Shoemaker-Levy 5, which was hurtling toward a July 1994 collision with the planet Jupiter. Hubble's high

resolution images showed that the approximately 20 objects that make up the comet are much smaller than originally estimated from observations with ground-based telescopes. (NASA Release 93-188; *USA Today*, Oct 15/93; *S F Chron*, Oct 15/93; *RTW*, Oct 14/93; *W Post*, Oct 25/93)

- NASA took action to limit expenditures on the Advanced Solid Rocket Motor (ASRM) program. NASA informed its field installations involved with the ASRM that if the pending appropriations bill becomes law, it would require termination of the ASRM program. (NASA Release 93-189)

- Antarctic ozone levels have reached record lows, according to data obtained by scientists at NASA's Goddard Space Flight Center, Greenbelt, Maryland, and the National Oceanic and Atmospheric Administration (NOAA), Climate Monitoring and Diagnostic Lab, Boulder, Colorado. Record low levels were recorded at the South Pole Station, Antarctica, at the end of September and early October 1993 and confirmed by satellite measurements. (NASA Release 93-190; *B Sun*, Oct 16/93; *AP*, Oct 18/93; *NY Times*, Oct 19/93; *W Post*, Oct 19/93; *USA Today*, Oct 19/93)

- The United States, Canada, Japan, and the European Space Agency (ESA) have invited Russia to help them build a new Space Station, according to an announcement by the ESA. (*RTW*, Oct 18/93; NASA Release N93-650)

- Space Shuttle Columbia, carrying seven astronauts, 48 rats, and a medical research lab, blasted into orbit for a record 14 days of experiments to learn more about keeping astronauts healthy during long voyages in weightlessness. The research was also expected to shed light on other health issues, including hypertension, anemia, and osteoporosis. This mission was only the second mission in 58 Shuttle trips focused entirely on medical research.

For most of the planned investigations, astronauts were to serve as both experimenters and subjects, donating blood, saliva, and urine samples for post-flight analysis. They also planned to participate in several tests to characterize changes in the vision, balance, perception, and other senses affected by the loss of gravity.

The launch, which took place four days late after two earlier launch attempts had been derailed by bad weather and technical problems, had a trouble-free countdown. The Shuttle was scheduled to land November 1 at Edwards Air Force Base. (*UPI*, Oct 18/93; *RTW*, Oct 18/93; *AP*, Oct 18/93, Oct 20/93; *B Sun*, Oct 19/93; *USA Today*, Oct 19/93; *W Post*, Oct 19/93; *RTW*, Oct 19/93; *NY Times*, Oct 20/03)

October 19: By firing small jets 10 times in one-minute bursts, NASA engineers have raised the orbit of the giant Compton Gamma-Ray Observatory by 66 miles and saved it from crashing to Earth. The observatory was scheduled to travel around Earth in an egg-shaped orbit until late November when a sec-

ond series of firings was to circularize its travels so that it would be at 280 miles altitude all around the globe. (AP, Oct 19/93)

- The House of Representatives voted to deny funding requests for two science projects: President Clinton's request for \$640 million for the superconducting Super Collider and \$4 billion for NASA's request to build a more powerful Space Shuttle engine. (AP, Oct 19/93; *W Post*, Oct 20/93; *USA Today*, Oct 20/93, Oct 21/93; *NY Times*, Oct 20/93; *W Post*, Oct 21/93, Oct 22/93; *C Trib*, Oct 22/93; *B Sun*, Oct 25/93)

- NASA said that engineers have launched a review of the Space Shuttle Columbia's liftoff to identify debris seen near Columbia's three main engines. A spokesman said that the Shuttle performed flawlessly during its ascent, but that officials were intrigued by video images that captured an object "of unknown origin" falling into the fiery engine plume about 45 seconds after liftoff. (RTW, Oct 19/93)

October 20: NASA Administrator Daniel S. Goldin announced that the Office of Space Flight would assume responsibility for management of the Space Station Program. Jeremiah W. Pearson III, Associate Administrator of Space Flight, was scheduled to lead the integration of these major programs. (NASA Release 93-1291; AP, Oct 20/93)

- NASA announced that the mystery of the "fastest flickering" galaxy, Galaxy NGC 6814, had been solved. Astronomers discovered that the flickering is not related to the galaxy but rather to two stars that orbit each other near the line of sight between Earth and the galaxy. When the two stars—called a binary system—become aligned with each other in relation to Earth, the galaxy image appears much brighter. When the binary stars move out of alignment, the galaxy becomes dimmer. (NASA Release 93-192)

- The House of Representatives voted for the second time since June to reject financing for the Super Collider. Supporters said that the project appeared dead. (*NY Times*, Oct 20/93; *W Post*, Oct 20/93)

October 21: NASA announced that it planned to launch Shuttle Endeavour and seven astronauts on December 1 on a mission to repair the troubled Hubble Space Telescope. (UPI, Oct 21/93)

October 22: Scientists reported that NASA's Galileo spacecraft had detected changes in the interplanetary magnetic field as it passed the asteroid Ida on August 28. (NASA Release 93-193)

October 25: Tests of a new NASA-developed, in-flight weather information system show that it could help airlines save nearly \$6 million per year. The

Cockpit Weather Information Needs (CWIN) system draws on several commercial data sources to create radar maps of storms and lightning and reports of surface observations. In NASA simulations from March to July, pilots on 14 flight crews burned less fuel and flew fewer miles in avoiding bad weather using CWIN displays. (NASA Release 93-194)

October 26: NASA, the Alaskan Volcano Observatory (AVO) and Carnegie Mellon University, Pittsburgh, have agreed to a second robotic volcano exploration involving Dante, an eight-legged robot that attempted to explore Mt. Erebus in Antarctica earlier this year. (NASA Release 93-195; AP, Oct 26/93; *W Times*, Oct 31/93)

October 27: NASA Administrator Daniel S. Goldin announced that the United States plans as many as 10 Shuttle missions to the Russian Mir Space Station as the two countries prepare to join in the future development of a joint international Space Station. Goldin said that the plans for the dockings are contained in a NASA proposal for expanded cooperation in space with the Russians that he plans to submit to the Clinton administration early next week. The proposal calls for U.S.-led construction of an International Space Station in Earth orbit beginning in 1997. (*H Chron*, Oct 28/93; *NY Times*, Nov 5/98, Nov 13/93; *W Post*, Nov 4/98; *LA Times*, Nov 5/98, AP, Nov 5/98; *B Sun*, Nov 5/98)

October 28: A two-ton chunk of a Chinese reconnaissance satellite launched earlier this month fell into the Pacific Ocean 1,000 miles west of Peru, the U.S. Space Command said. (*USA Today*, Oct. 28/93, Oct 29/93; *P Inq*, Oct 28/93, Oct 29/93; *W Post*, Oct 28/93, 29/93; *NY Times*, Oct 26/93)

- Dinosaurs became extinct not as a result of a giant asteroid, as one theory holds, but because of an atmospheric change that left too little oxygen to support their inefficient respiratory systems, according to Gary Landis, a U.S. Geological Survey geologist. He was one of four scientists who presented the new theory at the Geological Society of America's annual meeting. (*P Inq*, Oct 28/93)

October 29: NASA announced that it had begun flight tests of a fiber optic control system that could result in lighter, more fuel-efficient airplanes with more capable control and monitoring systems. The tests, using the F/A-18 Systems Research Aircraft at NASA's Ames-Dryden Flight Research Facility, Edwards, California, were developing fiber optic systems that weighed less and took up less space than the copper wiring in today's aircraft. (NASA Release 93-199)

- NASA announced that starting in January 1994, the NASA Science Internet (NSI) would connect research sites in the United States with Russia's Space Research Institute (IKI) in Moscow. Nine additional Russian space-related institutions were to be connected through what is called the Russian Space Science Internet (RSSI). (NASA Release 93-196)

- Preliminary results from a U.S. Russian scientific expedition have shed new light on the geology of eastern Russia. The data was obtained in August and September by NASA and Russian scientists using NASA's Learjet Model 23 based at the John C. Stennis Space Center in Mississippi. The expedition studied a variety of sites on the Kamchatka peninsula; the data were to be used to study the geologic evolution of the volcanoes on the peninsula as well as the impact of large volcanic eruptions on the atmosphere and its chemistry. The data were also to be used to model thermal and dynamical aspects of volcanoes. (NASA Release 93-198)

- NASA announced that it had started flight tests of a fiber optic control system that could result in lighter, more fuel-efficient airplanes with more capable control and monitoring systems. The tests, which used the F/A-18 Systems Research Aircraft, took place at NASA's Ames-Dryden Flight Research facility, Edwards, California. (NASA Release 93-199)

October 30: NASA announced a new initiative that would create Louisiana's first formal concentration of aerospace engineering courses at the historically Black Southern University and A&M College, Baton Rouge, Louisiana. NASA's five-year, \$2.5 million grant was intended to help the university develop an aerospace engineering undergraduate option in the department of mechanical engineering. (NASA Release 93-197)

- An article in *New Scientist* suggested that many failures in space are not the fault of electronics or software, but something more fundamental—the mechanics. The article identified a number of space missions that had problems caused by mechanical failures. Examples include the mission involving the European Retrievable Carrier (EURECA); Germany's TVSAT1, a direct broadcast satellite launched in November 1987; and the Hubble Space Telescope. (*New Scientist*, Oct 30/93)

November

November 1: Dr. David J. Larkin and team members from NASA's Lewis Research Center, Cleveland, Ohio, announced a new silicon carbide crystal growth process, called "site competition epitaxy," in a paper presented at the International Conference on Silicon Carbide and Related Materials in Washington, DC. The new growth process can be used to produce superior silicon carbide semiconductor electronic devices, which can withstand temperatures much higher than conventional semiconductors. (NASA Release 93-200)

- The Space Shuttle Columbia landed smoothly at Edwards Air Force Base after 14 days in orbit, ending the Shuttle program's longest flight with a wealth of new data on weightlessness in humans. Columbia's mission was only the second in U.S. history totally devoted to medical research. The Shuttle logged 5.8 million miles and circled Earth 225 times during its journey, which began October 18. Columbia performed well but sustained damage to thermal barriers around engine heat shields and to its protective tiles. Both problems have occurred before and will continue to be investigated, a NASA spokesperson said.

Shortly after touchdown, Columbia's seven crew members were taken on stretchers to a base lab, where they were to undergo new tests before their bodies had time to readjust to Earth's gravity. The crew, including two physicians, a biochemist, and a veterinarian, conducted medical research during the mission. They pedaled bicycles, drew blood samples, dissected laboratory rats, and performed other tests in a self-contained space clinic. The tests were designed to provide new clues on how harmful effects of weightlessness can be counteracted during long space voyages. The astronauts conducted more than 125 tests intended to help solve such medical riddles as why muscles weaken, bones soften, and red blood-cell production drops during lengthy space journeys. (*USA Today*, Oct 20/93, Oct 27/93, Nov 1/93, Nov 2/93; *NY Times*, Oct 20/93, Oct 21/93, Oct 22/93, Oct 31/93, Nov 1/93, Nov 2/93; RTW, Oct 19/93; Oct 20/93, Oct 21/93, Oct 25/93, Oct 26/93, Oct 27/93, Oct 30/93, Oct 31/93, Nov 1/93; UPI, Oct 19/93, Oct 20/93, Oct 21/93, Oct 25, Oct 27/93, Oct 31/93, Nov 1/93; AP, Oct 20/93, Oct 21/93, Oct 22/93, Oct 25/93, Oct 26/93, Oct 27/93, Nov 1/93, Nov 2/93; *Antelope Valley Press*, Oct 22/93; *W Times*, Oct 25/93; Reuters, Oct 23/93; *W Post*, Oct 31/93, Nov 1/93, Nov 2/93; *B Sun*, Oct 31/93, Nov 2/93; *Phil Inq*, Oct 31/93, Nov 2/93; *LA Times*, Nov 2/93)

November 2: A spokesman said that NASA had delayed loading the Hubble Space Telescope's replacement parts into Space Shuttle Endeavour because a fine, sandy substance had been found on two sealed plastic bags containing instruments needed to repair the telescope. A wind storm was thought responsible. Officials were to inspect the instruments to make sure they had not been damaged. NASA did not believe the inspection would delay the mis-

sion's target liftoff of December 1. (AP, Nov 2/93; RTW, Nov 2/93, Nov 4/98; B Sun, Nov 4/93)

November 5: NASA and the Ozark Heritage Region, Southern Missouri, announced that they would sponsor a two-day conference to provide information to minority and women-owned businesses interested in contracting opportunities with NASA. The conference was scheduled for December 1-2, 1993, at the Civic Center, West Plains, Missouri. (NASA Release 93-201)

November 8: NASA announced that it had officially kicked off Phase II of its High-Speed Research Program, a partnership with U.S. industry to develop technology that could enable the development of a next-generation supersonic airliner. (NASA Release 93-202)

- NASA announced that in one of the deepest celestial surveys yet made by the Hubble Space Telescope, astronomers had discovered a small group of previously unknown interacting galaxies estimated to be three billion light-years away. Because Hubble caught the galaxies in an early stage of evolution, they offer new clues as to how galaxies have changed over time. (NASA Release 93-203)

- Dr. John Peoples Jr., director of the Fermi National Accelerator Laboratory in Illinois, was appointed to take over direction of the dismantling of the Superconducting Super Collider in Texas. Dr. Peoples was to replace Dr. Ray F. Schwitters, the Super Collider's founding director, who resigned last week after Congress decided to terminate the \$11 billion project. (NY Times, Nov 9/93)

- NASA held a marathon, 59-hour dress rehearsal of the agency's \$251 million mission to service the Hubble Space Telescope and repair its flawed vision. The 11-day mission aboard the Shuttle Endeavour was planned for December 1.

Despite its flawed mirror, the Hubble telescope has produced a steady stream of important discoveries. More than 290 Hubble-based scientific papers have been published around the world. (B Sun, Nov 7/93, Nov 9/93, Nov 15/93; W Post, Nov 22/93)

November 9: NASA announced that sea surface measurements taken by the U.S.-French TOPEX/Poseidon satellite have confirmed that conditions are ripe for development of an El Niño even in the eastern equatorial Pacific Ocean this winter. (NASA Release 93-205; USA Today, Nov 10/93)

- NASA said that it would headquarter its first-ever Small Business Outreach Program at the New Hampshire Technical College in Nashua. The outreach program is a pilot project designed to assist New England businesses competing for NASA contracts. (NASA Release 93-206)

November 10: NASA researchers at Goddard Space Flight Center, Greenbelt, Maryland, and the University of Hawaii have discovered a faint spot of infrared emission that moves across Jupiter in concert with the orbital motion of its Moon Io. The image is caused by the electrical interaction between Io and Jupiter's magnetic field. (NASA Release 93-208)

November 12: NASA announced the selection of 317 research proposals for immediate negotiation of Phase I contracts in NASA's 1993 Small Business Innovation Research Program (SBIR). Over 2,850 proposals were submitted by small, high technology businesses from all parts of the United States. (NASA Release 93-207)

November 13: NASA Administrator Daniel S. Goldin and a team based at the Jet Propulsion Laboratory in Pasadena, California, which manages most planetary flights, have examined a variety of options for a new mission to Mars to achieve the scientific goals of the lost Mars Observer at less cost. The flight would be launched no earlier than 1996. (*W Post*, Nov 13/93)

November 14: Funds for NASA's Search for Extraterrestrial Intelligence (SETI) have been cut from NASA's budget. (*NY Times Magazine*, Nov 14/93)

November 15: NASA announced that Jet Propulsion Laboratory (JPL), Pasadena, California, scientists have developed a multifunctional glass that detects pollutants in the air by a dramatic change in color. Dr. Albert Stiegman, a JPL chemist, and his associates described the development in a paper in the journal *Chemistry of Materials*. (NASA Release 93-209)

- NASA awarded 20 universities grants for the first phase of a new training program that ultimately would create a cadre of young engineers skilled in multi-disciplinary design and analysis methods. Each university was to get about \$50,000 to define a multi-disciplinary curriculum and graduate-level research program in the aeronautics field that would be accomplished with industry. The universities also were to prepare proposals for Phase II of the effort. (NASA Release 93-210)

- NASA announced that it had cleared the instruments scheduled to be used for the Hubble Space Telescope repair mission. It was feared that the instruments had been contaminated by sandy grit that had seeped into the cargo room where the equipment was being stored. The grit problem forced NASA to move the Endeavour to a different launch pad. (*B Sun*, Nov 16/93; *W Times*, Nov 16/93; *USA Today*, Nov 16/93; *RTW*, Nov 15/93)

November 16: NASA Administrator Daniel S. Goldin told a Senate panel that the U.S. space program "is in chaos" because of congressional budget cuts. NASA's five-year budget plan dropped from \$106 billion last year to \$71 bil-

lion. Noting that NASA's budget changed every two or three months, Goldin called on Congress to institute a multiyear budget that would enable the agency to develop a strategic plan. (*USA Today*, Nov 17/93; *W Times*, Nov 17; *Reuters*, Nov 16/93, Nov 17/93; *Fla Today*, Nov 17/93)

November 17: NASA announced that USN Captain Richard N. Richards would command the STS-64 mission scheduled for the fall of 1994 aboard Discovery. The STS-64 mission was scheduled to carry the LIDAR In-Space Technology Experiment (LITE), a project to measure atmospheric parameters from a space platform utilizing laser sensors, the Robert Operated Materials Processing System (ROMPS) to investigate robot handling of thin film samples, and the Shuttle Pointed Autonomous Research Tool for Astronomy (Sparton-201), a free-flying retrievable x-ray astronomy platform. (NASA Release 93-204)

- NASA announced that the flight of Space Shuttle Endeavour on Mission STS-61 to repair the Hubble Space Telescope (HST) was scheduled for December 1, 1993. The flight was the first in a series of planned visits to the orbiting telescope. The 11-day mission was designed to accommodate a record five spacewalks with the capability for an additional two if needed.

The first HST servicing mission was to have three primary objectives: restoring the planned scientific capabilities of the telescope (because of a manufacturing mistake, Hubble's primary mirror was too flat along its edge by about 1/50 of the thickness of a human hair, leading to blurry images); restoring the reliability of HST systems; and validating the HST on-orbit servicing concept. (NASA Release 93-204; NASA Note to Editors N93-66; *USA Today*, Nov 18/93; *RTW*, Nov 17/93; *APn*, Nov 17/93; *B Sun*, Nov 17/93; *P Inq*, Dec 1/93)

- Yuri Koptev, head of the Russian Space Agency, said that Russia would definitely take part in the creation of a proposed Space Station with the United States. Work on the Station should start in 1997 and be finished by 2001. (*Reuters*, Nov 16/93; *P Inq*, Nov 26/93)

November 19: NASA announced that the Marshall Space Flight Center, Huntsville, Alabama, had been selected to design and build, in-house, the Space Station Furnace Facility, the first major element of Space Station scientific instrumentation and the focus of microgravity materials science research on the Space Station. (NASA Release 93-211)

- NASA said that it planned to launch a repair mission to the Hubble Space Telescope as planned next month despite a troublesome sensor on one of Shuttle Endeavour's wing flaps. The faulty sensor poses no safety problems, a NASA spokesperson said. (*APn*, Nov 19/93; *RTW*, Nov 19/93)

November 22: NASA announced that it had chosen five finalists from among the hundreds of suggested new names for the planned Space Stations: Unity,

Alliance, Aurora, Alpha, and Sigma. Former President Reagan dubbed the proposed Space Station "Freedom" in 1988 but President Clinton asked NASA for a new name this year to go along with a new design, lower costs, and Russian involvement on the project. NASA Administrator Daniel S. Goldin was scheduled to make the final choice in consultation with the White House. (*W Times*, Nov 22/93; *Apn*, Nov 19/93)

- NASA's \$30 billion Space Station survived its third, and presumably final, vote in the House of Representatives, when members voted 248-184 to keep it from being grounded by budget-cutters (*H Post*, Nov 23/93; *H Chron*, Nov 22/93)

- NASA said that scientists at the NASA-Langley Research Center had developed a radar that can detect wind shear before pilots fly into it. The FAA considers the Langley device an improvement over other wind shear radar on the market, according to an FAA spokesperson. NASA nominated Langley's radar work for the 1993 Robert J. Collier Trophy, a national award given annually by the National Aeronautics Association to those who have made the greatest achievement in aeronautics and astronautics. (*Daily Press*, Nov 22/93)

November 28: The countdown began for the Hubble Space Telescope repair mission, considered by many to be NASA's biggest challenge in space since the Apollo Moon landings. The Space Shuttle Endeavour was scheduled to lift off on the 11-day flight on December 1. (*B Sun*, Nov 28/93, Nov 29/93; *USA Today*, Nov 29/93; *P Inq*, Nov 29/93; *NY Times Magazine*, Nov 28/93; *USA Weekend*, Nov 26-28; *W Post*, Nov 28/93, Nov 29/93; *RTW*, Nov 27/93, 28/93; *APn*, Nov 27/93, Nov 28/93; *UPn*, Nov 26/93, Nov 28/93; *W Times*, Dec 1/93)

November 29: NASA satellite data, used to study the expansion and contraction of the deserts and semi-arid lands of Africa, are the principle data source providing early warning of potential famine and desert locust swarms. NASA announced that its Goddard Space Flight Center, Greenbelt, Maryland, and the U.S. Agency for International Development (AID) were cooperating on a project to provide data to AID's Famine Early Warning system. (NASA Release 93-213)

- America's technological leaders were scheduled to meet in Anaheim, California, from December 7-9 1993, to explore innovative ideas that could be used to solve engineering problems, create new products and industry opportunities, and facilitate the transfer of government-sponsored technologies to American industry. TECHNOLOGY 2003, the fourth annual national technology transfer conference and exposition, was sponsored by NASA, "NASA Tech Briefs" magazine, and the Technology Utilization Foundation. (NASA Release 93-212)

- NASA announced that it had selected the team of General Electric Corporation, Cincinnati and United Technologies Pratt & Whitney Division, West Palm Beach, Florida, for final negotiations leading to award of a contract to develop critical propulsion component technologies for a future U.S. high-speed civil transport. (NASA Release C93-dd)

November 30: NASA Administrator Daniel S. Goldin announced that NASA had awarded 8.5 percent of its 1993 fiscal year contracting budget to socially and economically disadvantaged firms, achieving a congressionally mandated goal of 8 percent for FY 1994 a year early. (NASA Release 93-214)

December

December 1: Daniel S. Goldin, NASA Administrator, announced agency plans to use its nearly completed Advanced Solid Rocket Motor (ASRM) Yellow Creek facilities in Iuka, Mississippi, for manufacture of nozzles for the current Space Shuttle Redesigned Solid Rocket Motor (RSRM) program. (NASA Release 93-215)

- President Clinton declared his support for building a Space Station in partnership with the Russians and received support for the project from key figures in Congress during a White House meeting on November 29. (*W Post*, Dec 1/93; *RTW*, Dec 1/97; *AP*, Dec 1/97; *APn*, Dec 1/93; *NY Times*, Dec 1/93; *USA Today*, Dec 1/93)

December 2: Law enforcement sources said that the FBI has been conducting a wide-ranging “sting” investigation into allegations of fraud at NASA’s Johnson Space Center, including the possible payment of bribes and gratuities for the placement of medical products on the Space Shuttle. About six NASA employees, including an unidentified astronaut, about 15 contractor employees, and at least two major aerospace firms were potentially implicated, sources said. (*W Post*, Dec 3/93; *AP*, Dec 3/93; *UPn*, Dec 3/93; *RTW*, Dec 2/93; *USA Today*, Dec 3/93; *B Sun*, Dec 3/93; *W Times*, Dec 3/93; *WSJ*, Dec 3/93; *LA Times*, Dec 3/93; *C Trib*, Dec 3/93; *B Sun*, Dec 6/93; *H Post*, Dec 4/93; *H Chron*, Dec 7/93)

- After a one-day weather delay, Space Shuttle Endeavour lifted off before dawn on a mission to repair the out-of-focus \$3 billion Hubble Space Telescope. Four members of the Shuttle crew, made up of six men and one woman, were to take five planned day-long spacewalks in an attempt to restore the full capability of the Hubble observatory. (*WP*, Dec 3/93; *Dec 2/93*; *TRW*, Dec 2/93; *USA Today*, Dec 3/93; *B Sun*, Dec 3/93; *NY Times*, Dec 3/93; *APn*, Dec 3/93; *W Times*, Dec 3/93; *LA Times*, Dec 3/93)

December 4: The Department of Justice filed a complaint accusing Paul Buchanan, director of NASA’s Biomedical Operations and Research Office at Kennedy Space Center, of submitting false vouchers claiming lodging expenses for time spent in Washington, DC, while on temporary duty for NASA. (*Fla Today*, Dec 4/93; *C Trib*, Dec 5/93)

- A *New York Times* article reported that a debate is going on over the degree of danger posed by the Space Shuttle’s solid-fueled rocket boosters. Repeatedly this year, the boosters have shown alarming variations in their thrust, prompting a number of quiet NASA investigations and accusations by critics that the problem is a time bomb waiting to go off. (*NY Times*, Dec 4/93; *Fl Today*, Dec 7/93)

- China's state-run media reported that China had reached its first agreement with the United States to rent payload space in the U.S. Space Shuttle program for scientific research projects. Jian Jingshan, director of the Center for Space Science and Applied Research at the Chinese Academy of Sciences, said his center had rented eight payload booths to carry equipment for experiments in space physics. (*C Trib*, Dec 5/93)

December 6: NASA announced that the Ulysses spacecraft, which was on its way to explore the polar regions of the Sun, had become the first spacecraft to reach further south than the most southerly dip of the Sun's magnetic equator. Ulysses's observations revealed that the fast-moving stream of charged particles, called the solar wind, is twice as fast, but less dense, than near the Sun's equator. (NASA Release 93-217; *UPn*, Dec 6/93)

- NASA announced that it was working with industry partners to develop a new technology for parts tracking. The new technology, a small binary symbol similar to a checkerboard, can contain much more information and occupy less space than a bar code and be easily marked directly on a part's surface for permanent identification. (NASA Release 93-218)

- Space-agency officials from the United States, Europe, Canada, and Japan agreed to invite Russia to join them in building an International Space Station that would be the world's largest collaborative science project. (*WSJ*, Dec 7/93; *B Sun*, Dec 7/93; *TTw*, Dec 6/93)

December 7: Space Shuttle Endeavour's spacewalkers were the first to wear new spacesuit gloves that provide not only more thermal protection but also a better sense of touch than earlier models. The gloves are the first to have breaks in the gray silicone-coated Kevlar finger and palm surface so joints can bend easier. They are also insulated with Nomex felt for added warmth in space, where temperatures can plunge to hundreds of degrees below zero. (*USA Today*, Dec 7/93)

December 11: Director Dale Compton and Deputy Director Victor Peterson, the two top directors at NASA's Ames Research Center, were scheduled to retire at the end of the year. The retirements come at a time when women and members of minority groups have complained that the center's top jobs are reserved for an "old boy network" of white men. (*San Jose Mercury News*, Dec 11/93)

December 13: The Space Shuttle Endeavour landed at Cape Canaveral, Florida, after an 11-day mission to repair the Hubble Space Telescope.

The flight was considered the most complex mission in more than 12 years of Shuttle flying, the biggest space repair job ever, and NASA's biggest challenge since the Apollo Moon landings 20 years ago.

During their five spacewalks, astronauts successfully replaced two of three pairs of gyroscopes (used to position the telescope) and their control unit; replaced two solar panels that supply electricity; installed another set of corrective optics to compensate for flaw in signal to other instruments; fixed two magnetometers, which tell NASA the position of the satellite; upgraded the Hubble computer; and installed a new camera with corrective lenses to compensate for flaw in Hubble's primary mirror.

According to NASA scientists, Hubble's new optics would have to be fine-tuned and tested for six to eight weeks before NASA would be able to tell whether the repairs actually had worked. (RTW, Dec 6/93, Dec 7/93, Dec 8/93, Dec 9/93, Dec 12/93, Dec 13/93; APn, Dec, 8/93, Dec 9/93, Dec 13/93; WP, Dec 7/93, Dec 12/93; *W Times*, Dec 6/93; Dec 7/93, Dec 9/93, Dec 10/93; *USA Today*, Dec 6/93, Dec 7/93, Dec 9/93; Dec 10/93, Dec 13/93, Dec 15/93; *NY Times*, Dec 4/93, Dec 5/93, Dec 6/93, Dec 7/93, Dec 9/93, Dec 10/93, Dec 11/93; Dec 12/93; *LA Times*, Dec 5/93, Dec 7/93, Dec 9/93, Dec 10/93; Dec 13/93; CSM, Dec 6/93, Dec 7, Dec 10/93; *P Inq*, Dec 5/93, Dec 10/93; *B Sun*, Dec 5/93, Dec 6/93, Dec 7/93, Dec 9/93, Dec 10/93, Dec 11/93, Dec 12/93, Dec 13/93; Dec 19/93; APn, Dec 6, Dec 7/93, Dec 8/93, Dec 9/93, Dec 10/93, Dec 12/93, Dec 13/93; *W Times*, Dec 4/93, Dec 5/93, Dec 6/93; Dec 9/93, Dec 12/93, Dec 13/93; UPn, Dec 6/93, Dec 7/93, Dec 8/93, Dec 9/93, Dec 10/93, Dec 13/93; *Time*, Dec 12/93; *O Sen*, Dec 7/93, Dec 9/93, Dec 11/93; *W Post*, Dec 4/93, Dec 5/93, Dec 6/93, Dec 9/93, Dec 11/93, Dec 12/93, Dec 13/93; *C Trib*, Dec 5/93, Dec 12/93; *Newsweek*, Dec 6/93; *WSJ*, Dec 9/93; *H Chron*, Dec 9/93; *H Post*, Dec 9/93; *Fla Today*, Dec 9/93, Dec 14/93)

December 15: NASA announced the selection of 130 research proposals for negotiation of Phase II contract awards in NASA's Small Business Innovation Research Program (SBIR). The SBIR goals are to stimulate technological innovation, increase the use of small businesses (including minority and disadvantaged firms) in meeting Federal research and development needs and increase private sector commercialization of results of federally-funded research. (NASA Release 93-219)

- Russia's space facilities in Kazakhstan appeared adequate to support the Clinton Administration's plan for a joint Russian-American Space Station program, but the United States may have to invest \$100 million for various improvements, Representative George E. Brown, J. (D-CA), said Tuesday. Brown, chairman of the House Space Science and Technology Committee, and a team of space experts from his committee toured the Baikonur Cosmodrome the week of December 5, 1993. (*LA Times*, Dec 15/93; *Defense Daily*, Dec 15/93; *Fla Today*, Dec 15/93)

- Engineers from Russian and American rocket companies were at Marshall Space Flight Center, Huntsville, Alabama, displaying a pair of Russian engines for sale to the American space program. Aerojet and Russian engi-

neers briefed Marshall Space Flight Center propulsion engineers on the design, manufacturing and test history of the engines, which date to the Soviet manned lunar program in the 1960s. (*Huntsville Times*, Dec 15/93).

- NASA has begun full-scale development of the first spacecraft to rendezvous with and orbit an asteroid. Called Near Earth Asteroid Rendezvous (NEAR), the mission received funding in the FY 1994 budget and was scheduled to be the first in NASA's new Discovery program of small-scale, cost-effective space exploration missions to be launched. (NASA Release 93-220)

- In the wake of Shuttle Endeavour's successful repair flight, commentators expressed their views on the significance of the mission. Writing in the *Washington Times*, Al Rossiter Jr., assistant vice president at Duke University, argued that the Endeavour astronauts who fixed the Hubble Space Telescope during five successful spacewalks should have removed any lingering doubts about the usefulness of people in space and the value of the Shuttle as an orbital service station.

Commentator Michael D. Lemonick, writing in *Time*, asked "What will NASA do for an encore?" noting that while the flight to fix the Hubble Telescope might have been a triumph, the agency's future was still clouded. William J. Cook, writing in *U.S. News and World Report*, after praising the Endeavour mission, argued in favor of building a U.S. Space Station and of adding Russia as a partner in the project. An *Orlando Sentinel* editorial agreed that the stunning success of the Hubble repair mission had put NASA back on track for greater challenges, such as creating a Space Station. This view was shared by the writer of a *C Trib* editorial. *USA Today's* "Opinion Line" recorded other positive responses from the U.S. media. (*W Times*, Dec 15/93; *Time*, Dec 20/; *U.S. News and World Report*, Dec 20/93; *O Sen*, Dec 11/93; *USA Today*, Dec 15/93; *C Trib*, Dec 18/93)

- NASA said that the agency had ordered special tests for all 44 of Shuttle Discovery's small nose-and-tail steering jets after a microscopic puncture was found in one of the thrusters. The tests could delay Discovery's next mission by as much as a week, possibly longer if any thrusters needed to be replaced. (*Fla Today*, Dec 15/93; *APn*, Dec 14/93)

- An unmanned probe was scheduled to be launched in 1996 to orbit the asteroid Eros, a giant rock that periodically passes close to the Earth. The spacecraft was to be built and operated by the Johns Hopkins University Applied Physics Laboratory for NASA. It will spend almost three years flying toward a rendezvous with Eros and then spend another year orbiting the asteroid. (*Apn*, Dec 16/93; *B Sun*, Dec 16/93; *RTW*, Dec 15/93; *AP*, Dec 16/93; *W Post*, Dec 20/93; *Defense Daily*, Dec 22/93)

December 16: NASA announced that NASA and the Russian Space Agency had agreed to up to 10 Shuttle flights to Mir with a total of 24 months time on board Mir for U.S. astronauts, a program of scientific and technological research, and the upgrade and extension of the Mir lifetime during the period 1995-1997. (NASA Release 93-222)

- NASA and the Russian State Committee for the Defense Branches of Industry signed a memorandum of understanding in Moscow to cooperate in eight areas of fundamental aeronautical sciences. The agreement called for cooperative activities in the following areas: transition and turbulence, composite structures and materials, chemically reacting flows, thermal protection system materials, environmental concerns in aviation, hypersonic technologies, experimental test facilities, and advanced aerospace materials. (NASA Release 93-22)

- NASA officials said that the Hubble Space Telescope appeared to be functioning well, but that they would not know until February whether or not the Hubble's vision problems had been corrected. (*W Times*, Dec 16/93; *Fla Today*, Dec 14/93, Dec 16/93; RTW, Dec 15/93; UPn, Dec 15/93)

- The United States and Russia formally joined as partners on an International Space Station and announced that the first Russian astronaut would fly in the Space Shuttle Discovery in six weeks. Russia also accepted an invitation to join the United States, Europe, Japan, and Canada in building a revamped Space Station. (*NY Times*, Dec 17/93; *LA Times*, Dec 17/93; *B Sun*, Dec 17/93; *P Inq*, Dec 17/93; APn, Dec 16/93; *C Trib*, Dec 17/93)

December 20: NASA announced that scientists at Ames Research Center, Moffett Field, California, had created the first geographically precise image of the Earth "breathing"—removing and releasing carbon dioxide into the atmosphere. The dynamic computer model shows monthly changes for carbon dioxide released into the atmosphere as microbes decompose plant debris in the Earth's soil. (NASA Release 93-223; UPI, Dec 20/93)

- A *Washington Times* editorial questioned the wisdom of the space partnership between Russia and the United States, finding significant problems with the agreement. First, should the Russian fascists come to power, the United States would have provided a hostile government with very detailed insights into the state of our advanced technologies. Second, the writer charged, the United States was being tricked into purchasing obsolete equipment for the joint station; third, Russia's space launch base, called Baikonur, was reported to be badly decayed; and, fourth, there were issues of crew safety—two fires were known to have taken place in similar modules of Russian Space Stations and the Russians had not provided complete details of these events.

An editorial in the *Christian Science Monitor*, on the other hand, praised the agreement with Russia, noting that it was clear that manned space flight must become truly international because of the high costs involved with space programs. (*W Times*, Dec 20/93)

- NASA announced that it was phasing out support for six of the Centers for the Commercial Development of Space. The Centers losing funding were the Center for Advanced Materials, Battelle Laboratories, Columbus, Ohio; Center for Commercial Crystal Growth in Space, Clarkson University, Potsdam, New York; Center for Materials for Space Structures, Case Western Reserve University, Cleveland, Ohio; Center for Cell Research, Pennsylvania State University, University Park, Pennsylvania; Center for Space Transportation and Applied Research, University of Tennessee, Tullahoma, Tennessee; and Space Automation and Robotics Center, Environmental Research Institute of Michigan, Ann Arbor, Michigan. (NASA Release 93-225)

- NASA announced that it had successfully boosted its Compton Gamma-Ray Observatory into a higher orbit around Earth, a move that would keep the 17-ton satellite from reentering the atmosphere. The reboost extended the mission life of the observatory by five years and prevented a reentry in which large parts from the spacecraft could have struck Earth, said officials at the Goddard Space Flight Center in Greenbelt, Maryland, which managed the spacecraft. (NASA Release 93-224)

December 21: NASA announced that its Perseus remotely piloted research aircraft had made its first flight, beginning an ambitious test program that was intended to qualify the plane for operational atmospheric science missions. (NASA Release 93-227)

- A feature in the *NY Times* about Daniel S. Goldin, NASA Administrator, called him a “bold remodeler of a drifting agency.” Goldin was quoted in the article as saying that he believes “nonlinear thinking” is essential to the rebirth of NASA. (*NY Times*, Dec 21/93)

December 22: NASA reported that the agency had overcome a thruster glitch to successfully complete the reboost of its Compton Gamma-Ray Observatory (GRO), adding five years to the spacecraft’s on-orbit lifetime. (*Defense Daily*, Dec 22/93)

December 23: The final operational instrument on the Cosmic Background Explorer (COBE) spacecraft, NASA’s first spacecraft to explore the origins of the universe, was scheduled to be turned off after completing four years of landmark research, including confirmation of the Big Bang theory that says the universe was created in a single momentous explosion. (NASA Release 93-228; *NY Times*, Dec 24/93; APn, Dec 23/93)

- NASA scientists said they were “ecstatic” over their progress in bringing the Hubble Space Telescope back to life after this month’s repair mission. Hubble’s ground handlers at NASA predicted that they would focus the observatory completely by the end of January, about two weeks quicker than expected. (*H Post*, Dec 23/93; *APn*, Dec 29/93; *B Sun*, Dec 25/93)

January

January 3: After a White House meeting of top aides from several agencies, NASA issued a statement saying that its researchers had used human subjects in the 1960s and 1970s in investigations of the possible effects of exposure to radiation. It pledged to investigate fully whether the subjects were properly informed. Some Energy Department tests were first disclosed in 1986 in a report to Congress by the General Accounting Office. (*NY Times*, Jan 4/94)

- In a written statement, NASA Administrator Daniel S. Goldin said the Department of Energy had told his office that NASA was “involved in the sponsorship or co-sponsorship of some human experiments to determine the effects of radiation” during the 1960s and 1970s. Goldin did not say what experiments had taken place. He promised a full public accounting. “There is no place in this agency for human medical experimentation conducted in secrecy or without full respect for human dignity of each and every participant,” the statement said.

Goldin named Donald Robbins, Deputy Director of Space and Life Sciences at Johnson Space Center in Houston, to lead a team to search NASA records involving radiation tests on humans. Goldin said Robbins will “cooperate fully” with the Energy Department and independent review groups investigating the tests, including Congress. (*Fla Today*, Jan 4/94, Jan 6/94)

- An editorial in a major space journal urged that the European Space Agency (ESA) not abandon its Columbus space station module program, despite a redesign of the Freedom station in favor of a U.S./Russian station core. This threat, due to funding crises in Germany and Italy, would jeopardize one of ESA’s own justifications for existence. While ESA’s near-term strategy is to maintain Columbus and increase ESA’s participation in the station, its long-term strategy is for an advanced crew transfer spacecraft for station operations—a major European technological development. The U.S., Russia, Japan and Europe all need this new vehicle. Launched by Ariane-5, it should be ready around 2005-2007, after Columbus in 2001. Further, European managers rightly stressed that the station program should make better use of Ariane-5 for resupply as well as launches, but costs now 30 percent over budget must be reduced. (*AvWk*, Jan 3/94)

- The same journal also urged increased research funding to yield breakthroughs in human factors engineering to reduce future errors in civil aviation. With a fleet expected to double by 2010, according to a Boeing official, at the current rate of hull losses human error could cause a major accident every 10 days by 2006. The man-machine interface must be optimized between automation and man-in-the-loop. Several diverse key factors from the effects of long-range flights and information technology to national cul-

tural differences and air traffic control must be addressed. With government funding a critical factor, a 1990 FAA/NASA/DoD master plan remains a good guide. (*AvWk*, Jan 3/94)

January 5: The astronauts who made a nearly flawless repair mission to the Hubble Space Telescope said they owed much of their success to the extraordinary training that went into the high-profile mission. The seven-member crew was picked earlier and trained longer—nearly two years—than any previous Shuttle crew, including 400 hours rehearsing in deep water tanks. However, at their first post-flight news conference they cautioned that future Shuttle missions would not get the same kind of support from the space agency's money managers. The mission commander, Air Force Colonel Richard O. Covey, said that clearly the NASA budget was not a limitless amount of money.

NASA officials said that since its release December 10, Hubble had been undergoing focusing and engineering tests conducted by remote control from the Goddard Space Flight Center in Greenbelt, Maryland. (*B Sun* Jan 5/94)

- NASA officials said that Kennedy Space Center (KSC) had not been home to any secret radiation tests on humans, and no workers were unknowingly exposed to any harmful materials. "We do not do anything like that here," KSC spokesperson Lisa Malone said. Life science research underway at the Space Center mostly involves growing plants and food in an environmentally controlled chamber at Cape Canaveral Air Force Station as well as some muscle fatigue research in long-term bedrest studies to simulate weightlessness. The Johnson Space Center in Houston and the Ames Research Center near San Francisco are the facilities where most medical research on humans is conducted.

Agency spokesperson Michael Braukus noted that the agency was still organizing its efforts to find out exactly how NASA was involved in the nuclear research. NASA's use of radioactive materials has centered on developing rocket engines powered by nuclear reactions and using a nuclear reaction to generate electricity in space. Former astronauts Alan Bean and Gene Cernan said they had never served as human guinea pigs. (*Fla Today*, Jan 5/94)

- Two American scientists, Clark Chapman and David Morrison, wrote in *Nature* magazine that society might want to decide whether to pay for a sky survey to track comets and asteroids that could crash into the Earth with catastrophic results, so that governments could use nuclear arms to smash or divert them. NASA proposed a Spaceguard Survey to map all asteroids large enough to cause global catastrophe. It would cost \$50 million to set up and \$10 million in annual operating costs. (Reuters, Jan 5/94)

- NASA continued tests of the Research External Vision Display (REVD), a new optical system allowing pilots to see a runway during nose-high landings

without computer-generated views. The REVD, basically an upside-down periscope, is a system of lenses and mirrors that reflects the view of the runway under the aircraft nose to the pilot. NASA started the first of up to 20 tests on the device on an F-104 aircraft at its Ames-Dryden Flight Research Facility at Edwards Air Force Base, California. The REVD approach differs from that used in the European Concorde and Russian Tu-144 supersonic transports, which drop the entire nose of the aircraft in front of the windshield. It could be used on a future U.S. supersonic airliner. (NASA Release, 94-2)

- NASA Administrator Daniel S. Goldin announced receipt of a report investigating the loss of the Mars Observer mission. Dr. Timothy Coffey, director of research at the Naval Research Laboratory, Washington, DC, and chairman of the independent investigative board studying the Mars Observer failure, delivered the report to the NASA Administrator. Dr. Coffey “candidly pointed out management and technical concerns that must be addressed.” (NASA Release 94-1, 2/9)

- NASA awarded a four-year, \$39.8-million contract to the California Institute of Technology (CIT) for the design and development phase of the Advanced Composition Explorer (ACE) science payload. The science payload on the ACE spacecraft consists of nine instruments: a Solar Isotope Spectrometer; a Cosmic Ray Isotope Spectrometer; a Solar Wind Ionic Mass Spectrometer; a Solar Wind Ionic Composition Spectrometer; an Ultra Low Energy Isotope Spectrometer; a Solar Energetic Particle Ionic Charge Analyzer; a Magnetometer; an Energetic Electron, Proton, and Alpha-particle Monitor; and a Solar Wind Electron, Proton, and Alpha-particle Monitor. (NASA Release C94-a)

- The Mars Observer spacecraft, the first U.S. mission to study Mars since the Viking missions 18 years ago, fell silent three days before entering orbit around Mars. NASA officials reported the probable cause of communication loss as a rupture in the fuel (monomethyl hydrazine—MMH) pressurization side of the spacecraft’s propulsion system. This would have caused an unsymmetrical pressurized leak of helium gas and liquid MMH, resulting in a net spin rate, which in turn would have put the craft in a contingency mode. Tests conducted at the Jet Propulsion Laboratory (JPL) at Pasadena, California, yielded several possible failures. Goldin asked Dr. Wes Huntress, Associate Administrator for NASA’s Office of Space Science, to conduct a thorough review of the findings and recommendations and to report back in the near future on corrective actions to be taken by NASA. (NASA Release 94-1; *USA Today*, Jan 6/94; *NY Times*, Jan 6/94; *B Sun*, Jan 6/94; *WSJ*, Jan 6/94; *W Post*, Jan 6/94; *LA Times*, Jan 6/94; *W Times*, Jan 6/94)

January 6: NASA Administrator Daniel S. Goldin announced a number of management appointments and organization structural changes at NASA

Headquarters and various Field Centers. The changes will affect NASA science, technology, research facilities and major programs, as well as the agency's Advisory Committee structure.

New Center Directors: Dr. Ken Munechika, executive director of the Office of Space Industry of the State of Hawaii, was appointed Director of the Ames Research Center at Moffett Field, California. Kenneth J. Szalai was appointed the new director of the Dryden Flight Research Facility, which was to become a separate entity from Ames. Project reporting lines would directly link the centers and the NASA Headquarters offices that Dryden supports, thus reflecting the commitment by NASA to reduce layers of management.

Dr. Carolyn Huntoon, Director of Space and Life Sciences at the Johnson Space Center, Houston, Texas, since 1987, and formerly the Center's Associate Director, was appointed Director of the Center. G.P. Bridwell was appointed Director of the Marshall Space Flight Center, Huntsville, Alabama. Donald J. Campbell was appointed Director of the Lewis Research Center, Cleveland, Ohio.

Key appointments at NASA Headquarters: Michael I. Mott was appointed Associate Deputy Administrator (technical), reporting to the Administrator on analyses of the early stages of programs and reviews of major issues. Thomas (Jack) J. Lee was appointed Special Assistant for Access to Space, to lead NASA efforts to define a technology program to retain U.S. leadership in space. Dr. Charles F. Kennel was appointed Associate Administrator for Mission to Planet Earth. Dr. Mark Abbott was named Chief scientist of the Office of Mission to Planet Earth. Lawrence J. Ross, former Director of the Lewis Research Center, was appointed Director of the Wind Tunnel Program Office, reporting to the Office of the Administrator.

Because of major expansions in the Space Station program, Administrator Goldin made several key appointments there: Wilbur C. Trafton, was appointed Deputy Associate Administrator for the Space Station. Randy Brinkley was assigned as the Space Station Program Manager, for management of all United States-Russian activities in Phase I and Phase II, to ensure implementation of the International Space Station. He was mission director for the recent Hubble Space Telescope servicing mission (STS-61). Captain William Shepherd, USN, was to continue as manager for all technical activities related to the International Space Station, reporting to Brinkley, and thus concentrating on the design, development, and assembly of the Space Station. Daniel C. Tam was assigned as Deputy Program Manager for Business in the Space Station Program Office at the Johnson Space Center, handling all business management operations.

The NASA Advisory Council also acquired new leadership: Dr. Bradford W. Parkinson, was appointed head of the Council. Anne L. Accola was appointed staff director of the Council. (NASA Release 94-3; *Cleveland Plain Dealer*, Jan 8/94; *Bakersfield Californian*, Jan 7/94; *Antelope Valley Daily News*, Jan 8/94; [Houston] *Citizen*, Jan 19/94; *National Journal*, Jan 15/94)

- Systems Integration Group, TRW's Fairfax, Virginia-based subsidiary, was awarded a NASA contract for \$173 million to manage a network of computerized ground stations receiving data from government satellites that observe the Earth's environment and climate changes. (*W Post*, Jan 6/94)

- Dr. R. Malcolm Brown, Jr., a University of Texas botanist and expert on bacterial cellulose, has created a new substance by fermenting sugar using a particular bacteria strain which he maintains can replace normal cellulose and be used in numerous applications, including producing edible spacesuits. NASA, along with the U.S. Department of Agriculture and the State of Texas, financed his research. (*WSJ*, Jan 6/94)

January 7: Intermetrics, Inc., of McLean, VA, was awarded an \$81-million, 10-year contract as part of NASA's Mission to Planet Earth. It provides Independent Verification & Validation (IV&V) of the Earth Observing System (EOS) Data and Information System (EOSDIS), for the Goddard Space Flight Center (GSFC), Greenbelt, Maryland. EOS was projected to generate about one trillion bytes of new data per day, offering access to data on the Earth's ecosystem, permitting scientists to distinguish natural from human-made changes. (NASA Release C94-b)

January 8: Russian Space Mission Control spokesperson Alexander Volchenkov announced that the Soyuz TU-18 rocket had lifted off Saturday for rendezvous with the orbiting Mir Space Station. Aboard were three cosmonauts, one of whom may attempt a new record for living in space. The craft was scheduled to dock with Mir for a crew change, after 200 days in space for the current crew.

January 10: The crew for the STS-66 mission aboard Atlantis in the fall of 1994 was selected. Air Force Lieutenant Colonel Donald R. McMonagle was to command the mission, called ATLAS-03. This third Atmospheric Laboratory for Applications and Science (ATLAS) mission would continue Spacelab studies of solar energy effects on the Earth's climate and environment. USAF Major Curtis L. Brown, Jr., was named pilot; Scott E. Parazynski, M.D., Joseph R. Tanner, and ESA astronaut Jean-Francois Clervoy, mission specialists; and Ellen Ochoa, Ph.D., payload commander. Tasks included the CRISTA-SPAS Cryogenic Infrared Spectrometer Telescope for Atmosphere on the Shuttle Pallet Satellite, jointly with Germany. (NASA Release 94-4; *Def Daily*, Jan 12/94)

- The crew for the STS-67 mission aboard Columbia for late 1994 was announced. Stephen S. Oswald was to command the Astro-2 astronomy mission to study the far ultraviolet (UV) spectra of faint astronomical objects and polarization of UV light from hot stars and galaxies. USAF Major William G. Gregory was named pilot, Navy Lieutenant Commander Wendy

B. Lawrence mission specialist, Ronald A. Parise and Samuel T. Durrance payload specialists, Tamara E. Jernigan payload commander, and John M. Grunsfeld mission specialist.

- A flight plan change seven months before the Mars Observer launch may have caused the craft's failure. Its propellant tanks were pressurized not five days after launch but eleven months into the flight as it reached Mars, thereby apparently causing a catastrophic rupture in a fuel line that spun the craft out of control. Pressuration, needed to fire the braking rockets to put the craft into orbit around Mars, involves opening previously closed valves and releasing high-pressure helium to squeeze the hydrazine fuel and nitrogen tetroxide oxidizer from separate tanks to mix and ignite. Minute amounts of condensed oxidizer possibly reached the hydrazine fuel, ignited, and ruptured the pipes, which released propellant into space and caused the uncontrolled spin. Peter G. Wilhelm, director of the Naval Center for Space Technology, a panel member who focused on the propulsion system, said that the team debated the change extensively, and JPL project manager Glenn E. Cunningham stated that the team considered and rejected an option to change valves as too costly and slow, and as a procedure that might have meant missing the 1992 launch window, thus requiring a two-year launch delay. (*W Post*, Jan 10/94)

Three unmanned supply craft were scheduled to visit Mir during this mission. A U.S.-Russian agreement signed in December worth \$400 million to Russia over the next four years called for up to 10 U.S. Shuttle flights to Mir. (*AP*, Jan 8/94; *UPI*, Jan 8/94; *Reuters*, Jan 8/94)

- Martin Marietta Corporation announced it would not claim a \$21.3 million on-orbit performance fee and would return \$17 million already received because of the failure of the Mars Observer craft. The total cost of the craft and its instrument cargo was \$1 billion. Referring to the presumed explosion caused by a change in the flight plan with an 11-month delay in pressurizing a system, discussed in the four-volume report but omitted in news media interviews, Dr. Timothy Coffey, director of research at the Naval Research Laboratory and leader of the panel investigating the failure, said that "had JPL been more closely involved with Martin Marietta in the development of the spacecraft, it is conceivable this issue would have been identified earlier." (*NY Times*, Jan 11/94; *W Post*, Jan 11/94)

- Dr. Timothy Coffey, director of research at the Naval Research Laboratory, Washington, DC, and chairman of the independent investigative board studying the Mars Observer failure, delivered the report on the Mars mission to NASA. The spacecraft, the first U.S. mission to study Mars since the Viking missions 18 years ago, fell silent three days before entering orbit around Mars. Despite lack of any communication with the craft, the board found that the probable cause of the loss of communication was a rupture of the fuel

(monomethyl hydrazine—MMH) pressurization side of the spacecraft's propulsion system. This would have caused an unsymmetrical pressurized leak of helium gas and liquid MMH, resulting in a net spin rate, which in turn would have caused the craft to enter a contingency mode. Tests conducted at the Jet Propulsion Laboratory (JPL) at Pasadena, California, yielded several possible failures. The board discussed a number of other concerns of a procedural nature. (NASA Release 94-1; *USA Today*, Jan 6/94; *NY Times*, Jan 6/94; *B Sun*, Jan 6/94; *WSJ*, Jan 6/94; *W Post*, Jan 6/94; *LA Times*, Jan 6/94; *W Times*, Jan 6/94)

January 11: NASA reported that tests of corrections made to the Hubble Space Telescope (HST) were proceeding well and that the first new pictures were expected within days. David Leckrone, Hubble project senior scientist and NASA public information officer Mike Finneran at Goddard Space Flight Center, Greenbelt, Maryland, expressed great satisfaction with progress made. To perform one of its primary mission objectives, the study of the universe's infancy, the HST must concentrate 70 percent of an object's light within a core image only 0.1 arc-second in diameter, but the HST's previous spherical-aberration defect distorted its 2.4-meter (94.5-inch) main mirror to the extent that only 15 percent of the light reached the sharp-focus zone. Two sets of corrective optics were installed—the Wide-Field Planetary Camera (due for replacement, anyway) and the Corrective Optics Space Telescope Axial Replacement (COSTAR), a two-meter-long set of five pairs of coin-size mirrors. A problem of jittering caused by solar-cell arrays was also resolved, and new gyroscopes, magnetometers, and computer electronics were installed and have been tested. (CSM, Jan 11/94)

- Over 200 scientists at a conference at the University of Maryland, College Park, Maryland, planned observations of the coming impact of the newly discovered Comet Shoemaker-Levy-9 into Jupiter. University of Maryland astronomer Lucy McFadden, the conference organizer, discussed the preparations. Twelve observatories in Europe and the United States were scheduled to work in a joint effort called the Comet Impact Network Experiment. The astronomers were organizing observations by nearly every large observatory on the Earth as well as by the Hubble Space Telescope, other orbiting observatories, and the Kuiper Airborne Observatory. Astronomer Michael A'Hearn compared the anticipated power of the impact of the comet's train of 21 two-mile-diameter fragments in terms of nuclear explosions with that of the 6 to 12-mile-diameter comet that hit Yucatan, Mexico, 65 million years ago. Harvard University astrophysicist George Field said each fragment would unleash energy equal to 10 million megatons of TNT. Paul Chodas of the California Institute of Technology discussed the problems of predicting the impact for observations by the Galileo spacecraft. Both visible, infrared, and spectrographic observations were to be performed. (*B Sun*, Jan 11/94; *AP*, Jan 12/94; *W Times*, Jan 12/94)

- TRW, Inc., received a seven-year, \$172-million contract to build the EOS Data and Operations System (EDOS), part of NASA's Earth Observing Data and Information System (EOSDIS). The contract called for TRW to build three facilities to deal with terabytes of climate data from the EOS platform each day, as part of an international study of worldwide environmental conditions. EOSDIS would be the largest database and archival system ever built and would process, distribute, and store two trillion bytes of data daily—about equivalent to the amount of information in the Library of Congress. EDOS would use a network called ECOM—EOS Communications—to send data from White Sands to over eight centers. (*Federal Computer Week*, Jan 10/94)

January 12: Dr. Carolyn Huntoon, the new Director of the Johnson Space Center (JSC), appointed George W.S. Abbey as Deputy Director of JSC. He succeeded Paul J. "P.J." Weitz, who was to serve as Acting Associate Director during transition of the new Center management team and who had been the Center's Deputy Director since 1987 and Acting Director since August 1993. (NASA Release 94-26; *Def Daily*, Jan 12/94)

- A study by Loren Thompson, Deputy Director of Georgetown University's National Security Studies Program, was one of several major sources examining the U.S. space industry's growing challenge from competition and domination by foreign governments' expanding space programs and their successes with smaller but cheaper launch vehicles.

Richard DalBello led another study by the White House's Office of Science and Technology Policy (OSTP), while Mark Albrecht of Science Applications International Corporation (SAIC) expressed the industry's concern. Further, the U.S. Senate Armed Services Committee (SASC) was to study launching U.S. military satellites on Ariane-5.

Norman R. Augustine, chairman of Martin Marietta, which had agreed to buy General Dynamics Corporation's rocket division for \$208 million, stressed that the industry was on its way to "being destroyed" if the U.S. government didn't help. The company wanted a law saying federal agencies must launch payloads only on U.S.-built rockets. As competitors, Europe's Arianespace, Russia's Proton, and China's Long March offer increasingly reliable alternatives to the U.S. launch industry's former monopoly that extended through the 1970s. The foreign rockets offer substantial savings through remarkably lower production and servicing costs.

Building the Proton takes one-fifth the employee hours needed to make a U.S. rocket, and it spends only a few hours on the launch pad, with a launch crew of 50. Ariane-4 spends 10 days, with a launch crew of 100, whereas the U.S. Deltas and Atlases need three to eight weeks and crews of 300, and the Titan IV takes three months and a crew of 1,000. Finally, for payload launch, the Russians and Chinese launches cost \$4,000 per pound and Ariane-5 cost \$8,000 per pound, while U.S. rockets cost \$12,000. A table compares six cost factors of the seven major rockets. (*W Post*, Jan 12/94; *H Chron*, Jan 23/94)

- White House officials said President Clinton was scheduled to name a civilian panel of scientists to independently review human radiation test data in hundreds of thousands of documents uncovered by a government-wide search and to determine whether ethical standards had been violated. Energy Department spokesperson Michael Gauldin said the panel members would consist of health physicists, experts on radiology, and specialists in medical ethics. He also said that an interagency “working group” formed to coordinate the search of records in eight agencies and departments was trying to define more clearly what experiments should be included. He predicted it would take “months, perhaps years” to find all the records and analyze them. (*W Post*, Jan 12/94)
- A dispute of possible long-term import with hundreds of millions of dollars at stake appeared to be brewing between NASA and the television industry over local multipoint distribution service (LMDS), pitting the satellite industry against proponents of this low-cost alternative to cable television. Further, the Federal Communications Commission (FCC) was approaching an auction of some airwaves for a new generation of wireless communications services. Charles Force, NASA Associate Administrator for Space Communications, stated that “It appears that there is a significant possibility for interference with LMDS from satellite uplinks; this was no secret to the FCC.” He suggested a four-year delay in LMDS service to deal with interference in the disputed 27.5-to-30-gigahertz spectrum band. The FCC believed that LMDS can coexist with satellite use and was preparing to authorize nationwide deployment of LMDS. (*LA Times*, Jan 12/94)
- Lieutenant General Malcolm O’Neill, director of the Ballistic Missile Defense Organization (BMDO), proposed to Pentagon Acquisition Chief John Deutch cancellation of the purchase of four Russian Topaz II space nuclear reactors—believed to be the last in Russia’s inventory—to be used in the DoD’s Thermionic System Test Evaluation. Steven Aftergood, of the Federation of American Scientists, said that the Air Force might take over the ground test program. The Nuclear Electric Propulsion Space Test Program, with which they might have been used, was also dropped. These moves continued a trend in the cancellation of several NASA and Air Force efforts to develop space nuclear power. A White House Space Nuclear Power Interagency Working Group was scheduled to draft administration policy by July 1994 and a U.S. position for the February meeting of the United Nations Committee on Peaceful Uses of Outer Space (COPUOS) Science and Technology Subcommittee. (*Def Daily*, Jan 12/94)
- NASA Chief Engineer Michael Griffin, Director of NASA’s former Exploration Office, planned to resign to join Space Industries International, Inc., as senior vice president of program development. (*Def Daily*, Jan 12/94)

- McDonnell Douglas awarded Computer Sciences Corp (CSC), with EER Systems and CTA, Inc., a five-year, \$49 million subcontract to support NASA's Goddard Space Flight Center (GSFC). The Systems Engineering, Integration and Management Support Services contract would support several space observation missions. (*Def Daily*, 12 Jan/94)

January 13: Dr. Gary A. Bower, an astronomer at the Space Telescope Science Institute (STI) in Baltimore, said at an American Astronomical Society (AAS) conference that Hubble Space Telescope (HST) repairs were successful and would enable the HST to measure the velocity of stars and other matter rotating near the centers of galaxies and thereby more firmly establish the existence of black holes. (*NYT*, Jan 13/94; *Reuter*, Jan 13/97; *AP*, Jan 12/97; *AP*, Jan 13/94)

- Astronomer Holland C. Ford and COSTAR project manager Dr. Jim Crocker, both with the Space Telescope Science Institute (STScI) at Johns Hopkins University, expressed scientists' jubilation at the remarkable photos from the recently repaired Hubble Space Telescope (HST). COSTAR is the Corrective Optics Space Telescope Axial Replacement package that repaired the HST. Dr. Gary A. Bower, an HST astronomer in a group of 1,800 attending an American Astronomical Society (AAS) conference in Crystal City, Virginia, predicted that the HST would be able to confirm evidence of black holes at the center of galaxies. Dr. Edward J. Weiler, an HST program scientist at NASA Headquarters, reserved judgement. (*B Sun*, Jan 13/94; *AP*, Jan 13/94)

- Engineers William Weist and Ray McLaughlin, with three other scientists and pilots of AlliedSignal, Inc., have since October 1991 been flying a converted 1952 Convair with powerful, updated turboprops at 300 feet in Florida testing a new system to detect low-level wind shear. In summer, bursts of concentrated cold air descend to the ground and violently spread out horizontally in all directions, causing unpredictable changes in wind direction at low altitude. Identified only two decades ago, wind shear has since 1964 caused at least 26 aircraft accidents in the U.S., killing more than 500 people. Although airports are installing radar, the Federal Aviation Administration (FAA) reported that air-traffic controllers might need two minutes to warn pilots, who might have only 10 seconds to react. In contrast, this system can warn in 50 seconds, despite analyzing four million pieces of information per second and filtering out ground clutter such as traffic. (*WSJ*, Jan 13/94)

- The Earthwinds balloon flew 200 miles in seven hours from Reno, Nevada, over the Sierra Nevada and landed 200 miles north of Los Angeles in its fourth failed attempt since its initial try in February, 1992, to make the first nonstop round-the-world flight. The hourglass-shaped craft about the length of a football field consists of an upper teardrop-shaped, helium-filled bag sep-

arated by a three-man crew capsule from its lower round, air-filled anchor balloon. The project, sponsored mainly by hotel magnate Barron Hilton, has cost \$7 million to date, with \$700,000 for non-reusable balloons and helium for each flight. Project manager Don Engen expected no new flight this season, but project advisor, Apollo XVII commander Gene Cernan, predicted another attempt. (*Reuters*, Jan 12/94)

- SETI Institute President Frank Drake announced that the organization in Moffett Field, California, will work with private backing, despite cancellation by NASA due to a funding cut by Congress. SETI—the Search for Extraterrestrial Intelligence—was to continue as the new Project Phoenix, with some NASA scientists doing the latter half of the former NASA project, which had been a sky survey by the Jet Propulsion Laboratory and a targeted search by NASA's Ames Research Center. They planned to target areas around 1,000 nearby Sun-like stars. The NASA project was begun as a \$100-million, ten-year project on October 12, 1992, the 500th anniversary of Columbus' landing in the Americas, but was stopped less than one year into its planned 10-year life. Observations were now planned to last into the next century. Major donors included Arthur C. Clarke through the British Interplanetary Society (BIS) and the founders of Hewlett-Packard, Intel, and Microsoft. It was announced that \$4.4 million of the \$7.3 million needed for the next year had been raised. (*Reuters*, Jan 12/94; AP, Jan 13/94)

- NASA and the California Institute of Technology (CIT) signed a five-year, five-billion-dollar, cost-plus-award-fee contract to manage NASA's 7,300-member Jet Propulsion Laboratory (JPL). This contract consolidated two previous contracts for CIT, which has managed JPL since NASA's inception in 1958. JPL, NASA's lead site for solar system exploration, designed and built the Wide Field/Planetary Camera (WF/PC II) recently installed on NASA's Hubble Space Telescope (HST). It also runs programs such as NASA's Mission to Planet Earth, its Galileo mission to Jupiter, and the Magellan mission to Venus, as well as the U.S. half of the NASA/ESA Ulysses mission to the Sun, the NASA/CNES TOPEX/Poseidon, and the SIR-C/X-SAR radar system on the Shuttle. (NASA Release C94-c)

January 14: NASA Administrator Daniel S. Goldin declared that, after five weeks of engineering checkout, optical alignment, and instrument calibration, the Shuttle mission to repair the Hubble Space Telescope (HST) was fully successful. He spoke at a press conference at NASA's Goddard Space Flight Center, Greenbelt, Maryland, along with Dr. John H. Gibbons, presidential assistant for science and technology, and Senator Barbara A. Mikulski, chair of the Appropriations Subcommittee on VA, HUD, and Independent Agencies (including NASA), who unveiled two new HST pictures. The repairs have extended astronomers' view across the universe by 10 times and enlarged the visible volume of space by 1,000 times. (NASA

Release 94-7; *W Times*, Jan 14/94; *B Sun*, Jan 14/94; *P Inq*, Jan 14/94; *WSJ*, Jan 14/94; *C Trib*, Jan 13/94; *NY Times*, Jan 14/94; *W Post*, Jan 14/94; *LA Times*, Jan 14/94; *Def Daily*, Jan 14/94; *AP*, Jan 14/94; *Reuters*, Jan 13/94; *UPI*, Jan 13/94, *USA Today*, Jan 14/94; *Htsvl Times*, Jan 16/94; *Time*, Jan 24/94)

- NASA Administrator Daniel S. Goldin announced the appointment of Brigadier General Elmer T. Brooks, USAF (Retired), as Deputy Associate Administrator for NASA's Office of Space Communications (OSC) at NASA Headquarters. Charles Force, Associate Administrator for Space Communications, commented on the problems facing NASA's use of telecommunications technologies with reduced funding. OSC was responsible for planning, development, and operation of NASA's worldwide communications, telemetry, and data acquisition activities. (NASA Release 94-9)

- The National Research Council (NRC) warned in a third and final report to NASA that its Earth Observing System (EOS) would not meet users' needs without major revisions in the \$2.6 billion EOS Data and Information System (EOSDIS) that was to handle, store, and distribute EOS data. An evolutionary system like EOSDIS must be open and extendable. The centralized nature of the EOSDIS Core System (ECS) being built was unresponsive to user needs and needed major revisions in its architecture, leadership, and user empowerment. Specifically, users would not be able to automatically combine data from different sensors or alter data products to meet particular needs. (*Def Daily*, Jan 14/94; *Federal Computer Week*, Jan 24/94)

- Russian cosmonauts Vasily Tsibliyev and Alexander Serebrov on the Soyuz TM-17 landed safely and without incident after six months in the Mir station, although the module had collided with Mir before descent. They were replaced by two cosmonauts, including Valery Polyakov, due to stay a record-breaking 14 months in space, to break the record 366 days set by Vladimir Titov and Musa Manarov in 1988—1989. (Reuters, Jan 14/94)

January 17: NASA announced that the Compton Gamma Ray Observatory satellite had yielded data indicating that gamma-ray bursts show relative "time-dilation"—"a result of the General Theory of Relativity"—suggesting they occur not only near the Milky Way Galaxy but also far away, and thus indicating expansion of the universe. (NASA Release 94-10)

January 18: NASA's Office of Advanced Concepts and Technology (OACT) scheduled a one-day forum, including an Aerospace Industry Technology Program (AITP), to encourage high-risk, high-payoff technology development. NASA responsiveness to industry's need was shown by industry participation in all aspects and phases of the AITP program, with representatives making presentations on both program content and structure. The fiscal 1994 budget allocation for this technology initiative was \$20 million. (NASA Note to Editors N94-6)

January 19: Ecologists Christopher Potter and Steven Klooster of NASA's Ames Research Center processed 10 years of data to construct a map charting one month's exchange of the heat-trapping gas carbon dioxide between the atmosphere and the Earth's land plants and soils. This is a key process in determining the extent to which the release of this gas through burning fossil fuels and land-use changes might cause global climate warming, and this is the first time satellite data have been combined with computer simulation of soil processes. A 1990 Intergovernmental Panel on Climate Change gave estimates in billions of tons of carbon per year to try to answer the question of where missing amounts of extra human-released carbon dioxide go. Princeton University geochemist Jorge L. Sarmiento hypothesized a terrestrial sink, while Harvard University geochemist Steven Wofsy agreed with Potter that simulation also needed detailed studies of plant-soil processes. (CSM, Jan 19/94)

- Turkey scheduled the launch of its first satellite aboard an Ariane-4 rocket from French Guyana. (*B Sun*, Jan 19/94)

- The Hughes Network Systems telecommunication firm contracted with the Hawaiian corporation ITTI to install a high-speed satellite link dubbed "Teleport Asia" between the Eastern and Western hemispheres on the island of Oahu, with twin Earth stations facing toward Asia and North America. (*W Times*, Jan 19/94)

January 20: Dr. Thomas S. Burks, executive vice president for research and academic affairs, and veterinarian Dr. Bradford S. Goodwin, professor and executive director for laboratory animal medicine and care at the University of Texas Health Science Center, discussed the scientific necessity of raising genetically uniform rats and mice. They are used as subjects for research throughout the community. NASA used four dozen aboard the Shuttle Discovery. (*H Chron*, Jan 20/94)

January 21: The NASA Lewis Research Center, Cleveland, Ohio, awarded the Engineering Design Group, Inc., Tulsa, Oklahoma, a contract for engineering, construction, and environmental services in the rehabilitation, modification and construction of research and institutional facilities and systems. This small-business cost-plus-fee contract had a two-year basic period and three one-year renewals, a base value of \$13.6 million, and a total value of \$45 million. (NASA Release C94-e)

January 24: Swales and Associates, Inc., Beltsville, Maryland, received an eight-year small business set-aside cost-plus-award-fee contract of \$275 million to support the Mechanical Systems Division of the Goddard Engineering Directorate at Goddard Space Flight Center (GSFC). (NASA Release C94d)

January 25: NASA's Johnson Space Center (JSC), Houston, Texas, selected Pioneer Contract Services for a five-year, \$42 million cost-plus-award-fee contract for logistics support, such as all handling of property, warehouse, and bondroom operations. (NASA Release C94f)

- NASA announced the crew of the STS-60 mission aboard the Space Shuttle Discovery, scheduled for flight from February 3 to 11, 1994: mission commander, Charlie Bolden; pilot, Ken Reightler; mission specialists, Jan Davis, Ron Sega, Franklin Chang-Diaz, and Sergei Krikalev, Russian cosmonaut with two long-duration flights aboard the Mir Station. His flight will begin a new three-phase era of cooperation: 10 Shuttle-Mir missions, joint work on the core Space Station, and expansion of the Station to all other partners.

The STS-60 will deploy the first Wake Shield Facility (WSF) to grow semiconductors. The WSF is a \$13.5 million, 12-foot-wide satellite that was to float free of the Shuttle for three days. If the vacuum-grown film yielded optimum growth, future fleets of shields might grow crops of such film. This would also mark the second flight of the 1,100-cubic-foot Spacehab facility for biotechnology and other payloads and the 100th Get Away Special (GAS) since its 1982 start, with five payloads. The crew also was to communicate with students in the United States and Russia with the Shuttle Amateur Radio Experiment-II (SAREX-II). STS-60 was scheduled to be the 18th flight of the Space Shuttle Discovery and the 60th flight of the Space Shuttle system. (NASA Release 94-11; *H Chron*, Jan 20/94; *H Chron*, Jan 21/94; NASA Note to Editors N94-9; AP, Jan 26/94, *P Inq*, Jan 28/94; *USA Today*, Jan 31/94; AP, Jan 30/94; AP, Jan 31/94; *UPI*, Jan 31/94; *B Sun* Feb 2/94)

- The University of Houston (UH) was scheduled to take over from the Massachusetts Institute of Technology as home for a rocket laboratory researching the feasibility of charged plasma propulsion for future interplanetary flight. The facility was to be called the Advanced Space Propulsion Laboratory. Astronaut and plasma-physics expert Franklin Chang-Diaz was appointed the facility's director. Chang-Diaz hoped to create a small test rocket to release from a Shuttle. (*H Post*, Jan 21/94)

- Carl Pilcher, who works on advanced planning issues in NASA's Office of Space Science, told the agency's Space Science Advisory Committee that top NASA managers were drafting a 12-20 page strategic plan giving highest budget priority to the Mission to Planet Earth (MTPE). The MTPE was due to the insistence of Vice President Gore, reflecting messages NASA Administrator Goldin was receiving from the White House in response to his submitted proposals. (*Def Daily*, Jan 21/94)

NASA and the Department of Defense (DoD) scheduled the launch of their joint project, the Deep Space Program Science Experiment, dubbed Clementine, on a Titan IIG rocket from Vandenberg Air Force Base, California. This first U.S. lunar mission in two decades was scheduled to spend two months

in polar orbit of the Moon every five hours, photographing it from as close as 250 miles with its three cameras (two infrared and one ultraviolet/visible) and LIDAR (laser image detection and ranging) unit, and then was to go on to photograph the near-Earth asteroid Geographos.

The 933-pound craft was built by the Naval Research Laboratory (NRL), which was to also oversee ground command; it was to be tracked by NASA's Deep Space Network. Its main goal: to test five sensors designed to detect and track missiles. The project's other goal was to aid in the design of light-weight and low-cost components usable in a fleet of missile-defense satellites or guided missiles, which could be tested without violating the Anti-Ballistic Missile Treaty. This reflected the project's roots in the Strategic Defense Initiative (SDI) or Star Wars, now called the Ballistic Missile Defense Organization.

Despite Apollo and later missions, NASA officials noted that the Moon, especially the far side, had never been mapped completely nor explored with modern instruments. The Clementine Program could provide the overall picture that researchers have always wanted. (*Orlando Sentinel*, Jan 24/94; *W Post*, Jan 24/94; *H Post*, Jan 24/94; *B Sun*, Jan 26/94; *NY Times*, Jan 26/94; *W Post*, Jan 26/94; *USA Today*, Jan 26/94; *W Times*, Jan 26/94; *AP*, Jan 26/94; *B Sun*, Jan 27/94)

- The media reported that Pratt & Whitney and Rockwell International were negotiating a potential \$1 billion deal with Russian aircraft manufacturer Ilyushin to produce jetliners. The project could involve the initial purchase of 20 aircraft by Aeroflot Russian International Airlines and create \$1 billion in U.S. exports. Pratt & Whitney would provide the engines and Rockwell would provide the avionics. The Il-96M is a four-engine wide-body craft that carries 300 passengers. (*P Inq*, Jan 22/94)

- Japan scheduled the launch of the H-2, its first rocket built without U.S. technology, whose development has taken 10 years and \$2.4 billion. A consortium of 74 Japanese companies built it and formed the Rocket Systems Corporation to market it. (*C Trib*, Jan 23/94, *NY Times*, Jan 26/94, *WSJ*, Jan 31/94, *Reuters*, Jan 30/94, *Reuters*, Jan 31/94, *Reuters*, Jan 30/94; *CSM*, Feb 3/94)

- NASA Administrator Daniel S. Goldin had an extensive interview with *U.S. Black Engineer (USBE) Magazine* on his past and current experience, commitment, and achievements in promoting minority advancement in the aerospace field. He detailed how in his long career in rising through the field he had worked for minority progress.

At TRW he worked with Hank Wilfong of the National Association of Small and Disadvantaged Businesses (SDB) in setting aside \$250 million and searching the country for the top 30 minority-owned businesses, and he succeeded in contracting high-tech electronics projects with them.

The interview mentioned government programs, including the President's National Technology Initiative and a congressional bill mandating NASA to do eight percent of its \$12 billion in contracted business with minority groups. Mentioned also were set-asides, DoD's mentorship program, and the Office of Federal Contract Compliance (OFCC).

Coming to NASA, Goldin found only 14 African Americans in the agency's 535 senior executive service (SES) slots. He instituted a hiring freeze until a new SES training program got underway. He also called in the chief executive officers (CEOs) of NASA prime contractors and told them to expand cultural diversity in their subcontractor workforce.

- Joseph P. Martino, senior research scientist at the University of Dayton Research Institute, examined space launch costs in a study released by the Los Angeles-based Reason Foundation. Because of high costs, he noted that the United States was now farther away from having people on the Moon than when President Kennedy launched the Apollo program. In 1994, it cost \$3,500 per pound to put items into orbit. The cost increase started in the 1950s, when high performance of ballistic missiles was needed at any price and has been continued by NASA's policy of developing new technology for each new mission. Launch costs must be lowered and can be by three new approaches: the use of commercial practices for vehicle construction, long production runs of single designs, and designing launchers to be reusable like aircraft instead of producing single-use like missiles. (*W Times*, Jan 25/94)

- Dr. Edward Tagliaferri, a physicist and consultant for the Aerospace Corporation, an engineering firm in El Segundo, California, that helps the Air Force run its many satellite programs, was lead author of a report discussing declassified Air Force studies of meteors and their possible threat. The report is a chapter in a book edited by Dr. Tom Gehrels, a planetary astronomer at the University of Arizona, and published by the university. The potential threat is viewed in the light of occurrences such as the strike in Tunguska, Siberia, and the probable strike in Yucatan, Mexico. (*NY Times*, Jan 25/94)

- NASA's budget was scheduled to face possible major cuts according to top congressional sources. The Space Station, Earth Observing System, International Ultraviolet Explorer, Extreme Ultraviolet Explorer, Cosmic Background Explorer, Compton Gamma Ray Observatory, Mission Operations and Data Analysis, Cassini, AXAF, and two \$1-billion wind tunnels for the High Speed Civil Transport program could be affected.

NASA reconfigured its account structure into four parts: space science and aeronautics, Shuttle and Space Station activities, tracking and personnel, and research and program management.

The Space Station, however, had presidential support and was a signature foreign policy initiative, especially in terms of cooperation with the Russians, which may protect it. (*Def Daily*, Jan 24/94; *Sunnyvale Sun*, Jan 12/94)

- The NASA-DoD National AeroSpace Plane (NASP) achieved positive thrust for a scramjet engine at speeds of up to 9,500 miles per hour or Mach 14, according to contractor team member Pratt & Whitney. The tests were made at Calspan Corporation's hypersonic shock tunnel facility at Buffalo, New York. (*Def Daily*, Jan 24/94)

- Retired Air Force Colonel Ken Munechika, former chief of Onizuka Air Force Base's Satellite Test Center, was designated the new chief of NASA's Ames Research Center (ARC). (*Sunnyvale Sun*, Jan 12/94)

NASA established the Johnson Technology Commercialization Center, modelled on the Austin Technology Center, to promote space technology. The center was scheduled to accept and subsidize a few rigorously screened applicants as "start-up" and will nurture them through the "learning curve" over three years toward their "graduation" to independent operation in the marketplace. The program was part of NASA-sponsored Regional Technology Transfer Centers for technology assessment and licensing. Texas was also part of a 14-state Mid-Continent Technology Transfer Center, under the umbrella of the National Technology Transfer Center. (*H Post*, Jan 12/94)

- NASA's Office of Space Science was scheduled to use the Goddard Space Flight Center's Wallops Island Flight Facility to manage a Sounding Rocket Program of almost 50 missions worldwide in 1994. One study over Fairbanks, Alaska, was to examine auroras by using eight unguided suborbital sounding rockets at altitudes of 55 to 287 miles. One rocket was to carry a 21-foot-long payload called the Auroral Turbulence Rocket, with 28 instruments on a main payload and two subpayloads. The latter two would be deployed from the main payload in space, and simultaneous measurements from the three spacecraft would permit a study during 9 of the 12 minutes of flight. They were to measure the acceleration process that energizes particles and causes the emission of light called auroras. (NASA Release 94-12)

- Dr. Robert Wingate of NASA's Langley Research Center, Hampton, Virginia, as chairman of an investigation board appointed by Jeremiah Pearson, NASA Associate Administrator for Space Flight, released a study of the cause of an anomaly on Shuttle Discovery—STS-51. During deployment of the ACTS communication satellite, commands for firing a single explosive cord caused the firing of both primary and backup cords, which ruptured a containment tube and released debris into the cargo bay. The study described the primary and contributing causes—a 10-year-old design flaw—and made recommendations for corrections. (NASA Note to Editors 94-8, *USA Today*, Jan 28/94; AP, Jan 27/94)

- Spence Armstrong, Associate Administrator for NASA's Office of Human Resources and Education, announced its Experimental Program to Stimulate Competitive Research (EPSCoR). This was a three-year, \$500,000 annual award to six states as a new initiative to improve their research and competitive capability while expanding education and training opportunities for women and minorities. The funding would enable states to develop an academic research enterprise for long-term, self-sustaining, nationally competitive capability, contributing to the States' economic viability. The involved states were Alabama, Arkansas, Kentucky, Louisiana, Montana, and the Commonwealth of Puerto Rico.

January 27: NASA's Goddard Space Flight Center opened its Clean Room—the world's largest at 100 feet by 125 feet and nine stories high—for journalists to inspect the 15,000 pounds of parts removed from the Hubble Space Telescope and returned for examination, particularly the Wide Field/Planetary Camera. Hubble flight systems chief Frank Cepollina and NASA expert John Wood discussed both the signs of wear from three years in space and problems of controlling contamination here. (*B Sun*, Jan 27/94; *AP*, Jan 27/94)

- British astronomers reported in the journal *Nature* on finding new physical evidence of “ripples” in space, hot and cold spots confirming 1992 findings by NASA's Cosmic Background Explorer (COBE) Satellite, that shed light on the origin of the universe. Rod Davies of the University of Manchester discussed studies done by radio telescope in the Canary Islands that revealed microwaves from when the universe was only 300,000 years old. Astrophysicist Joseph Silk of the University of California at Berkeley commented that the findings could offer the most intriguing possibility that the universe is open, i.e., would expand indefinitely. (*W Post*, Jan 27/94; *USA Today*, Jan 27/94; *AP*, Jan 27/94)

- The DC-X unmanned Delta Clipper-Experimental launch vehicle project was dropped by McDonnell Douglas because of exhaustion of its initial \$58 million funding by the Department of Defense (DoD). Bill Gaubatz, head of the project for McDonnell at the White Sands Missile Range in New Mexico, stated that DoD had informed him of cancellation of the contract.

The 42-foot-tall, 21-ton cone-shaped test model is one third the size of envisioned vehicle, which would be able to lift up to 25,000 pounds of cargo into orbit. The rocket was part of DoD's Ballistic Missile Defense Organization (BMDO) program to lift missile defense shields and weapons to orbit, but a final \$5 million was shifted to DoD's Advanced Research Projects Agency (ARPA). ARPA, in turn, was reported to have been instructed by Defense Undersecretary John M. Deutch not to release the funds. (*LA Times*, Jan 27/94; *NY Times*, Jan 31/94)

January 28: *Science* reported the results by researchers from Columbia and the University of California, San Diego, refuting past studies on global warming. They found flaws in a 1993 study of deep-core Greenland ice by European scientists that said global warming could cause abrupt, disruptive cold along the North Atlantic Ocean. The U.S. researchers said that Earth's climate is remarkably stable and likely to remain so. (*USA Today*, Jan 28/94)

- Numerous Federal agencies, including NASA's Jet Propulsion Laboratory (JPL), were accused in a Senate report of "offloading" by devising elaborate practices for circumventing Federal law so that hundreds of millions of dollars in government business could go to favored companies. The Senate Governmental Affairs subcommittee on oversight of government management said they had "abused and misused" the law and otherwise could have cut costs by half. (*W Post*, Jan 28/94)

- German Economics Minister Guenter Rexrodt urged the U.S. to grant concessions in international talks on aerospace subsidies, particularly NASA's indirect subsidies on R&D. This issue was not dealt with in the 1993 General Agreement on Tariffs and Trade (GATT) agreement. Germany was studying ways to shift direct support, and Deutsche Aerospace AG has released a 10-point program. (Reuters, Jan 27/94)

January 31: As part of NASA's High-Speed Research Program, NASA's Ames Research Center (ARC) was using its National Full-Scale Aerodynamics Complex to study and curb the noise from the takeoff exhaust or "plume" of turbulent air in the wake of future supersonic jetliners without affecting take-off performance. Project Manager Paul Soderman, an aeronautical and acoustical engineer, said that such future aircraft would have to comply with Federal Aviation Administration (FAA) regulations. An exhaust nozzle of an "ejector suppressor" type was being studied by laser and infrared video. (NASA Release, Jan 31/94)

- NASA reportedly transferred \$990,000 to the Defense Department's Ballistic Missile Defense Organization to maintain the Delta Clipper program. McDonnell Douglas Aerospace had developed a rocket that takes off and lands vertically, which is covered by this program. NASA wished to keep the option of using the DC-X as a flight demonstrator of single-stage-to-orbit technologies in support of NASA's advanced launch technology effort. The program was operated from the White Sands Missile Range in New Mexico. (RTW, Jan 31/94; *H Post*, Feb 3/94)

February

February 1: The Pentagon announced that Under Secretary of Defense for Acquisition John Deutch had agreed to hold \$10 million in Advanced Research Projects Agency (ARPA) funding pending the outcome of a Department of Defense (DoD) launch modernization study and a 60-day NASA-DoD review of the Delta Clipper-Experimental (DC-X) flight test program. (*Defense Daily*, Feb 2/94; *NY Times*, Feb 2/94; *AP*, Feb 2/94; *H Post*, Feb 3/94)

February 2: NASA announced a major milestone in the Space Station Program as of February 1, with the signing by NASA and contractor officials of documents ending the Freedom Work Package contracts. NASA had signed these agreements with Boeing Defense and Space Group, McDonnell Douglas Corporation, and the Rocketdyne Division of Rockwell International. Instead, responsibility for design, development, and integration of work on the International Space Station program was being concentrated in a single contract with Boeing Defense and Space Systems Group, Seattle. (NASA Release 94-15)

- Although Congress killed NASA's search for extraterrestrial intelligence (SETI) program, the subject survived as Project Phoenix. The SETI Institute in Moffett Field, California, indicated existing contributions of \$4.4 million of the \$7.3 million needed for the project. NASA renamed the project High Resolution Microwave Survey to reflect the technology's ability to screen out Earth-based radio interference while listening for cosmic signals on millions of channels at once. (*CSM*, Feb 2/94; *W Post*, Feb 15/94)

February 3: Shuttle Discovery blasted off from Cape Canaveral carrying for the first time a Russian cosmonaut, Sergei Krikalev, who already had spent 15 months aboard Mir Station, and five American astronauts. Discovery's eight-day research flight was to include deployment and retrieval of the Wake Shield Facility, designed for growing experimental semiconductor materials, and various microgravity and life science experiments. (*AP*, Feb 3/94; *UPI*, Feb 3/94; *Reuters*, Feb 3/94; *LA Times*, Feb 4/94; *P Inq*, Feb 4/94; *W Times*, Feb 4/94; *W Post*, Feb 4/94; *NY Times*, Feb 4/94; *USA Today*, Feb 4/94; *WSJ*, Feb 4/94; *C Trib*, Feb 4/94; *AP*, Feb 4/94)

- NASA announced the selection of astronauts Norman E. Thagard and Bonnie J. Dunbar as prime and backup crew members for a three-month flight on Russian Space Station Mir in March 1995. Both astronauts flew on previous U.S. Shuttle flights and conducted various scientific experiments. (NASA Release 94-16)

- NASA announced the first government/industry Technology Reinvestment Program (TRP) with Hi-Shear Technology Corporation, Torrance, California.

The program was designed to create a new generation of portable emergency rescue equipment by using NASA-developed pyrotechnical technology to free accident victims from wrecks. (NASA Release 94-17)

- The launch of the H-II (also seen as H-2) rocket created by the Japanese consortium Rocket Systems Corporation was scheduled for February 4. The rocket, large enough to lift a two-ton payload into geostationary orbit, cost \$2.5 billion to develop and was two years behind schedule. (CSM, Feb 3/94; Reuters, Feb 4/94; UP, Feb 4/94; *LA Times*, Feb 7/94)
- Air Force Colonel Sanford Mangold told members of the House of Representatives Government Operations Committee of his dismissal for recommending the cancellation of the \$27 billion military satellite program Milstar. He considered Milstar, intended to provide worldwide military communications during a nuclear war, to have “fundamental, insurmountable problems,” including “unacceptable” costs of \$1.4 billion for each satellite. (*NY Times*, Feb 3/94)
- Following a final flight ceremony at NASA’s Dryden Flight Research Facility at Edwards Air Force Base, NASA retired its last F-104 fighter jet of the 1950s. NASA used the plane, known as the Starfighter, for biomedical research and to simulate the X-15 jet. The F-15 was to replace Lockheed’s Starfighter. (*Bakersfield Californian*, Feb 4/94)

February 4: NASA announced the selection of 42 additional proposals for negotiation of Phase II contract awards in its Small Business Innovation Research Program (SBIR). The programs supplemented the 130 firms announced in December 1993. (NASA Release 94-18)

- Andrea Donnellan, a geophysicist at NASA’s Jet Propulsion Laboratory in Pasadena, California, stated that Oat Mountain in the Santa Susana range, north of the San Fernando Valley, had jumped several inches during the 6.6 earthquake that hit Los Angeles January 17. NASA collected data from a global network of 45 stations. (NASA Release 94-19; *W Post*, Feb 8/94; *P Inq*, Feb 13/94; *National Black Review*, Feb/Mar/94)

February 5: Burton J. Squires, an engineer at NASA’s Goddard Space Flight Center, in a letter to the editor of the *Washington Post*, commented on the media’s failure to commend the outstanding success of the Hubble Space Telescope repair mission. (*W Post*, Feb 5/94)

February 6: On February 5 and 6, NASA astronauts tried unsuccessfully to put the Wake Shield Facility satellite in orbit. They encountered problems first with radio interference from the Shuttle and then with failures in the satellite’s guidance and navigation system. (UPI, Feb 6/94; Reuters, Feb 6/94; *NY*

Times, Feb 6/94; *W Post*, Feb 6/94; *NY Times*, Feb 7/94; *W Post*, Feb 7/94; *USA Today*, Feb 7/94; *P Inq*, Feb 7/94; *B Sun*, Feb 7/94; *AP*, Feb 7/94)

- Johnson Space Center Director Carolyn Huntoon announced some organizational changes, including the closing of offices connected with integrating programs with the Russian Space Station Agency and the New Initiatives Office. (*Fla Today*, Feb 6/94)

February 7: On February 9, the Discovery was to launch the Orbital Debris Radar Calibration Spheres, designed to help locate "little junk" orbiting in space, which could pose a hazard to space flight. (*CSM*, Feb 7/94)

- NASA announced a new Mars exploration program in fiscal year 1995 involving the development of a small Mars Surveyor orbiter. The Jet Propulsion Laboratory, Pasadena, was to manage the program, which was designed to study the surface of Mars. (NASA Release 94-20)

- President Clinton, who was in Houston, spoke to the Discovery astronauts. Mission Control earlier had instructed them to abandon efforts to launch the Wake Shield Facility satellite. (*UP*, Feb 7/94; *W Times*, Feb 8/94; *WSJ*, Feb 8/94; *W Post*, Feb 8/94; *P Inq*, Feb 8/94; *LA Times*, Feb 8/94; *B Sun*, Feb 8/94; *USA Today*, Feb 8/94)

- An Air Force Titan 4, the most powerful U.S. unmanned rocket, boosted a \$1 billion military communications satellite (Milstar) into space. The satellite formed the initial link in a controversial \$17.3 billion data relay network designed to provide secure communications during a nuclear conflict. (*W Post*, Feb 8/94; *WSJ*, Feb 8/94; *B Sun*, Feb 8/94; *AP*, Feb 8/94)

- In the administration budget presented to Congress, NASA suffered a \$281 million cut for the Space Shuttle program, the first cut in 22 years. The budget proposals increased amounts for new technology, aeronautics, computers, and global warming research but required cancellation of the Long Duration Orbiter, the Commercial Experiment Transporter, and the Advanced Solid Rocket Motor. (*Reuters*, Feb 7/94; *B Sun*, Feb 8/94; *USA Today*, Feb 8/94; *AP*, Feb 8/94; *W Post*, Feb 10/94)

February 8: A feature article described the potential scenario envisaged by David Morrison, chief of space science research at NASA's Ames Research Center, Moffett Field, California, and Clark Chapman of the Planetary Science Institute and Science Applications International Corporation, Tucson, Arizona. Their 20-year study of asteroids led them to predict that the Earth was on a calamitous collision course with an asteroid that could kill 1 billion or 2 billion people. The odds of the collision in any one year were 1 in 500,000. (*USA Today*, Feb 8/94)

- Russian cosmonaut Krikalev aboard Discovery exchanged greetings with Russian cosmonauts aboard Space Station Mir. The Soviet cosmonaut also got through by ham radio to students in Mars, Pennsylvania. (AP, Feb 8/94; UP, Feb 8/94; Reuters, Feb 8/94; *W Times*, Feb 9/94; *B Sun*, Feb 9/94; *USA Today*, Feb 9/94)
- The Space Telescope Science Institute released photographs made by the repaired Hubble Space Telescope of comet fragments that were to smash into the planet Jupiter in July. The fragments were projected to strike with the force of 100 million hydrogen bombs, with the explosions so bright that the light would be reflected off Jupiter's moons. (Reuters, Feb 8/94; *B Sun*, Feb 9/94; *USA Today*, Feb 9/94; AP, Feb 9/94)

February 9: NASA's Lewis Research Center, Cleveland, Ohio, selected General Dynamics Commercial Launch Services, Inc., of San Diego, California, for contract negotiations for two definite launches and options for seven added launches using the Atlas intermediate expendable launch vehicle. The first mission was to be the Earth Observing System-AM-1 spacecraft scheduled for 1998. (NASA Release C94-g)

- NASA announced that as a result of a 10-year joint NASA-Army research program (the UH-60 Airloads Program) at NASA's Ames Research Center, Moffett Field, California, on helicopter rotor vibration, noise, motion, and airflows, future helicopters would be quieter and more efficient. (NASA Release 94-21; UPI, Feb 9/94)
- NASA announced the appointment of Robert E. Whitehead as Deputy Associate Administrator for the Office of Aeronautics at NASA Headquarters. (NASA Release 94-23)
- Shuttle Discovery launched three pairs of stainless steel spheres as part of a study of space debris in which ground stations were to track junk that could pose a collision hazard for spacecraft. On February 8, it left a small German satellite, Bremsat, in orbit to conduct six science experiments. (Reuters, Feb 9/94; *USA Today*, Feb 10/94; AP, Feb 10/94)

February 10: NASA's Office of Safety and Mission Assurance, in conjunction with NASA's Inventions and Contributions Board, created the Software of the Year Award to recognize such technology used by NASA. (NASA Release 94-22)

- NASA announced that results of joint NASA-industry research experiments to reduce exhaust emissions of future supersonic airliners to environmentally compatible levels substantially exceeded program goals. Using an engine fuel combustion chamber sector, NASA surpassed its goal of generat-

ing no more than 5 grams of oxides of nitrogen per kilogram of fuel burned at supersonic flight speed. (NASA Release 94-24)

- NASA announced that Shuttle Columbia was scheduled to take off in March on a two-week mission to conduct various experiments entailing such areas as materials processing, biotechnology, microgravity, medical concerns, and environmental monitoring. (NASA Release 94-25)

February 11: Space Shuttle Discovery returned to Earth after making an additional orbit because of bad weather at Cape Canaveral, Florida. In spite of its inability to release the Wake Shield Facility, that satellite was the site for growing high-grade semiconductor films while attached to Discovery. Discovery also conducted 12 experiments in Spacehab, a commercial laboratory, in the cargo bay. (NY Times, Feb 12/94; B Sun, Feb 12/94; W Post, Feb 12/94; AP, Feb 12/94)

- Boyce Mix, deputy manager for the Shuttle main engine program at NASA's Marshall Space Flight Center in Huntsville, Alabama, said that technicians at Paragon Precision Products of Valencia, California, had used a super-strength glue for as many as six years to make unauthorized repairs on Space Shuttle engines, without the knowledge of company officers. A January inspection revealed the glue and the situation was corrected. (AP, Feb 11/94; Reuters, Feb 12/94; W Post, Feb 12/94; NY Times, Feb 13/94; USA Today, Feb 14/94)

- NASA's Cleveland Lewis Research Center was scheduled to work with the Russians on a project to use the Sun's rays to power the Russian Mir Space Station. In addition, the Lewis Center was to direct the building of two wind tunnels desired by the commercial aircraft industry to help design airliners that fly at 2.4 times the speed of sound. The two projects would help compensate for jobs lost at Lewis by funding cuts. (Plain Dealer, Feb 11/94)

February 13: NASA's Astrophysical Data Service allowed access to an astronomical data base that ultimately was to contain nearly a billion stars and several million galaxies. The data resulted from the comprehensive National Geographic Sky Survey made by the Mount Palomar Observatory in the 1950s. To this, Mount Palomar added a second survey, underway for several years, of the northern sky covering more than 50 million galaxies and nearly 2 billion stars. (W Times, Feb 13/94)

February 14: Space Tec Ventures, a Hampton, Virginia company created by Joseph Casas, helped NASA's Langley Research Center in Virginia build a laser scheduled to be used to monitor Earth's environment from space. The laser was to measure the amounts of carbon dioxide in the atmosphere and was to be aimed at Earth from Space Shuttle Endeavour's cargo bay. The firm built two other lasers that were scheduled for NASA flights in August and September.

February 15: Glenn Cunningham, manager of the new program at NASA's Jet Propulsion Laboratory in Pasadena, California, said NASA planned a new program of Mars exploration. The program was to begin with the launching of two small unpiloted flights in November 1996. Launchings were to occur every 25 months over the next 10 years, using relatively low-cost spacecraft. Funds in the current NASA budget were to go for designing the first of the orbiting craft, the Mars Surveyor. Another Mars program, the Mars Environmental Survey (MESUR), was to establish a seismic network on Mars. The program was to begin with the already authorized \$175 million Pathfinder mission. (*NY Times*, Feb 15/94; *CSM*, Feb 16/94)

- In an address to business executives, NASA Administrator Daniel S. Goldin also spoke of NASA's goal of putting a man on Mars. With the proper technical groundwork and economic and political conditions, Goldin felt 10 years was a reasonable time frame for accomplishing this. The plan was for innovative technology to cut the cost, such as drawing methane from Mars to use as fuel for the return trip, thus cutting the space vehicle's size in half. Another part of NASA's vision was to learn how to work together with other countries in space programs. (*Reuters*, Feb 15/94)

- Senator Barbara Mikulski, Democrat from Maryland, in addressing a Maryland Space Business Roundtable, warned aerospace contractors that congressional budget cutters were targeting NASA's Space Station; meanwhile other congressional members supported increased funds for human services programs and sought to cut from science and technology projects. Senator Mikulski stressed the importance of investments in science and technology within the framework of a balanced budget. (*B Sun*, Feb 16/94)

February 16: NASA announced that the official launch date of Space Shuttle Columbia would be March 3. During the 14-day flight, a five-person crew was to conduct numerous scientific experiments ranging from materials processing to biotechnology and environmental monitoring. (NASA Editor's Note N94-18; *AP*, Feb 16/94; *Reuters*, Feb 16/94; *W Times*, Feb 17/94)

- The European Space Agency (ESA) Governing Council announced in Paris it would proceed with a manned space program by the year 2000. Jean-Marie Luton, the French director general of ESA, said member states had approved a \$227 million Manned Space Transportation Program and construction of a \$299 million Columbus module to form part of the U.S. Freedom Space Station being prepared by NASA. The program was to include a Crew Transport Vehicle (CTV) to be launched by a European Ariane rocket. Meanwhile, Jan-Baldem Mennicken, chief of Germany's space agency DARA, revealed Germany's 1994 space program. Costing \$940 million, it was \$117 less than than for 1993. The budget included \$579 million for ESA, with the remainder including funds for international programs for Earth observa-

tion and a 20-nation project to send a satellite to Mars from the Russian Baikonur Space Center in October 1994. (Reuters, Feb 16/94)

February 17: Lawrence Dietlein, assistant director for life sciences at NASA's Johnson Space Center, Houston, said that in 1963 and 1974 the Center conducted experiments involving the use of very small doses of radiation on humans. The experiments, done with the consent of the subjects, concerned bone loss and weightlessness during space flight. (Reuters, Feb 17/94; *W Times*, Feb 18/94; *USA Today*, Feb 18/94)

February 18: Two NASA-sponsored scientists, Scott Hudson of Washington State University, Pullman, Washington, and Steven Ostro of NASA's Jet Propulsion Laboratory (JPL), Pasadena, California, created the first three-dimensional model of an asteroid based on radar data. The asteroid was the double-lobed 4769 Castalia, discovered by Eleanor Helen of JPL at the Mount Palomar Observatory in 1989. The model and resulting pictures appeared in the February 18 issue of *Science* magazine. (NASA Release 94-26)

- The Federal Aviation Administration (FAA) authorized airlines to begin using military satellite signals for navigation. The military's Global Positioning System, consisting of 24 orbiting satellites, according to the airlines would save them millions of dollars by flying more efficient routes. It was unclear what the FAA would do with existing microwave landing systems. (*WSJ*, Feb 18/94; *W Post*, Feb 18/94; *NY Times*, Feb 18/94)

- NASA's Deputy Associate Administrator for the Space Station Wilbur C. Trafton said he expected Russia to participate in the Space Station partnership in accordance with the agreement reached in 1993. Such participation was scheduled to allow the project to be completed in June 2002 instead of 2003 and save \$2 billion. If Russia should withdraw from participation, back-up plans existed. (AP, Feb 18/94; Reuters, Feb 18/94)

- Itar-Tass news agency reported from Moscow that nine the Russian women went into training for long-haul space flights by starting a four-month stint of lying with their heads below their feet. The Institute of Medicobiological Problem was in charge of the experiment, which simulated lengthy space flights aboard the Mir Space Station. One woman was to be selected to fly on Mir in November. (Reuters, Feb 18/94; *B Sun*, Feb 23/94)

February 20: Three cosmonauts aboard Russian Space Station Mir celebrated the eighth anniversary of the Soviet Union's launch of Mir in 1986. (AP, Feb 20/94; *W Times*, Feb 21/94)

February 22: A feature article described the work of astronomers at the Space Telescope Science Institute in Baltimore. The astronomers devised plans for a

Polar Stratospheric Telescope (POST) intended to reveal stars and galaxies in twice the detail possible with the Hubble Telescope and do so more cheaply. The telescope, which was to hang from a blimp tethered over the South Pole, was to be the prototype for a new generation of observatories that could follow Hubble into space. The Institute, together with Johns Hopkins University, a consortium of other universities, and two private manufacturers, planned to ask NASA for \$500,000 to \$1,000,000 for a six-month design and cost study. (*B Sun*, Feb 22/94)

- Norman Augustine, chairman of Martin Marietta Corporation, said the company would not buy General Dynamics Corporation's space-launch business for \$208.5 million as planned unless the government agreed to pay more for those services. Martin Marietta wanted a part of the more than \$400 million in savings it anticipated that the government could realize over 10 years as a result of Martin Marietta merging its Titan IV heavy-launch rocket business with General Dynamics' medium-lift Atlas-Centaur system. (*WSJ*, Feb 22/94)

- A 20-month long Justice Department sting operation centered on NASA's Johnson Space Center in Houston resulted in criminal fraud and bribery charges against nine employees and one contractor. Two other contractors, General Electric Corporation and Martin Marietta Corporation, which had employed two of those charged, agreed to pay the government \$1 million to cover cost of the undercover operation, code named Operation Lightning Strike. The two firms cooperated with the probe and might continue to do business with the government. Among the charged were Astro International Corporation of League City, Texas, and two NASA employees. The sting, conducted by the FBI, NASA's Office of Inspector General, and the Defense Criminal Investigative Service, particularly targeted NASA's Space and Life Sciences Division in Houston. In October 1993, NASA Inspector General Bill Colvin told Congress that NASA had some 400 criminal fraud investigations underway. (*Reuters*, Feb 22/94; *UP*, Feb 22/94; *W Post*, Feb 23/94; *W Times*, Feb 23/94; *USA Today*, Feb 23/94; *NY Times*, Feb 23/94; *B Sun*, Feb 23/94; *WSJ*, Feb 23/94; *AP*, Feb 23/94; *C Trib*, Feb 23/94)

- The new Canadian Liberal government announced that budget constraints obliged it to discontinue participation in NASA's planned International Space Station. Later, the Canadian government said this was a misunderstanding and that Canada's commitment was to be reduced. (*Reuters*, Feb 22/94; *UP*, Feb 22/94; *AP*, Feb 23/94; *AP*, Feb 24/94)

- NASA downplayed a slip in the first U.S. assembly launch for the Space Station, promising no more schedule bumps. Originally scheduled for launch in July 1997, the Boeing-built node was now scheduled for launch in December 1997. Moreover, the U.S. Habitation module was now scheduled for launch in March 2002 instead of January 2001. The program changes annoyed congres-

sional staffers because the program put more dependence on the Russians. NASA station chief Wilbur C. Trafton remained confident that the changes would not cause serious harm to station assembly. (*Defense Daily*, Feb 22/94)

- Jim Doyle, spokesperson for NASA's Jet Propulsion Laboratory, Pasadena, California, said that additional Federal funding would allow the Magellan Spacecraft to continue studying Venus' interior and atmosphere at least through September 1994. Space Shuttle Atlantis launched Magellan in May 1989, and it arrived at Venus 15 months later. (AP, Feb 28/94; *W Post*, Mar 1/94)

February 23: A NASA engineering team succeeded in lifting the endangered Compton gamma-ray observatory to a safe orbit after its propulsion system malfunctioned. NASA said the reboost had extended the mission life of the observatory by five years, thus meeting its original two-to-eight-year life span—it was launched on April 5, 1991. (CSM, Feb 23/94)

- NASA announced the selection of astronaut Kenneth D. Cameron to manage NASA operational activities at Star City, Russia, and at the Russian control center at Kaliningrad. (NASA Release 94-27)

- NASA's Office of Space Communications announced the installation of a Video Teleconference System facility at Brown University, Providence, Rhode Island, to expand video teleconferencing coverage to Russia. The installation supplemented the university's existing video teleconferencing capabilities with the Russian Institute of Space Research in Moscow. The new facility allowed NASA scientists and engineers to work directly with Soviet researchers. (NASA Release 94-28)

- Claude Arnaud, professor of medicine at the University of California, San Francisco, in a paper presented to the national meeting of the American Association for the Advancement of Science, stated that his research indicated that the bone-weakening process experienced by astronauts in space as a result of extended weightlessness might be corrected with common drugs that prevented calcium loss. (AP, Feb 23/94; UP, Feb 23/94; *USA Today*, Feb 24/94; UPI, Feb 28/94)

- The seven astronauts who repaired the Hubble Space Telescope in December 1993 were designated recipients of the Freedom Forum's Free Spirit Award. In their names, \$250,000 was to be donated to a scholarship fund for dependents of NASA employees. The award ceremony occurred on March 28. (AP, Feb 23/94; AP, Mar 28/94; UP, Mar 28/94; *USA Today*, Mar 29/94)

February 24: Spence Armstrong, NASA Associate Administrator for Human Resources, stated that in order to cut more than 1,000 jobs as Congress ordered, NASA needed to offer buyouts to staff. To restructure the Space

Station Freedom project, NASA had to cut 1,300 positions, but employees were not leaving in normal attrition numbers—an attrition of only 600 to 700 persons was predicted for fiscal 1994, without buyouts. NASA Administrator Daniel S. Goldin said further cuts would endanger NASA's entire mission. The Vice President's "reinventing government" group said NASA needed to accelerate its job cuts but stick with attrition and buyouts rather than reductions in force. The group offered no specifics as to positions NASA should cut. (*Federal Times*, Feb 24/94)

- Bernadette Cardenas, an aerospace engineer at the Johnson Space Center, Houston, filed a civil suit against astronaut Lt. Col. Charles (Sam) Gemar and his wife Charlene, also a NASA employee. The suit claimed the Gemars had harassed her mentally and physically; Mrs. Cardenas wanted to force Col. Gemar to submit to blood tests to establish paternity for her two-year-old son. NASA said the lawsuit would not prevent Gemar's participation in the forthcoming shuttle mission. (AP, Feb 24/94; *NY Times*, Feb 25/94; *B Sun*, Feb 25/94; *USA Today*, Feb 25/94)

- U.S. astronauts Norman Thagard and Bonnie Dunbar arrived in Russia to begin their yearlong training. The training was to stress physical conditioning, essential for long-duration space flights in order to counter bone and muscle deterioration. The astronauts were to wear Russian space suits bearing both Russian and U.S. flags. (AP, Feb 24/94; AP, Feb 28/94; UP, Feb 28/94)

- Celebrating National Engineers Week, more than 20 engineers from NASA's Dryden Flight Research Center visited classrooms around Antelope Valley to discuss their careers. (*Antelope Valley Press*, Feb 24/94)

February 25: NASA Administrator Daniel S. Goldin announced a report by the General Aviation Task Force of NASA's Aeronautics Advisory Committee. The report of the industry-led task force called on NASA to revitalize its general aviation program, make its wind tunnels, laboratories, and simulators more accessible to the general aviation community, and better balance its technology program to meet general aviation needs. The four areas on which the report called on NASA to concentrate were: propulsion, noise, and emissions work; aeronautical systems research; structure and materials development; and aerodynamics research. (NASA Release 94-29; *Wichita Eagle*, Feb 26/94)

- NASA announced that the U.S. component of the Global Geospace Science (GGS) program, the Wind and Polar spacecraft, would experience launch delays to give NASA a chance to examine the materials and process used to build two power subsystem electronic boxes on each spacecraft similar in design to those determined to be the cause of the NOAA-13 spacecraft failure in 1993. The decision followed a GGS technical review at NASA's

Goddard Space Flight Center, Greenbelt, Maryland. Instead of launches occurring in April and June 1994, they probably would occur in the next fiscal year. (NASA Release 94-30; *Defense Daily*, Mar 1/94)

- NASA announced the selection of Raytheon Service Company, Burlington, Massachusetts, to provide logistics support to the Mission Operation and Data Systems Directorate at the Goddard Space Flight Center, Greenbelt, Maryland. (NASA Release C94-h)

February 28: The countdown began for the liftoff on March 3 of Shuttle Columbia. Columbia was scheduled for a basic 14-day research flight featuring materials development and protein crystal growth as well as medical experiments. (*B Sun*, Feb 28/94; AP, Feb 28/94; UP, Feb 28/94; Reuters, Feb 28/94)

- NASA announced the addition of Jerry M. Linenger to the crew of the fall 1994 flight of Space Shuttle Discovery. The mission of this flight was scheduled to be complex, including a rendezvous, proximity operations, and a spacewalk; thus crew operations needed to be more efficiently distributed. (NASA Release 94-31)

- NASA announced that Marshall Space Flight Center, Huntsville, Alabama, was to develop and manufacture an improved, lighter version of the Space Shuttle External Tank. The Super Lightweight External Tank was to be made of aluminum alloys and weigh 8,000 pounds less than the current model. (NASA Release 94-32; AP, Feb 28/94; *Defense Daily*, Mar 1/94)

- NASA's Lewis Research Center, Cleveland, Ohio, announced the selection of Robert P. Madison International for an engineering, construction, and environmental services contract at the Lewis Research Center and at Plum Brook Station, Sandusky, Ohio. (NASA Release C94-i; *Defense Daily*, Mar 1/94)

- A ceremony held at NASA's Dryden Flight Research Facility marked its return to its former status as an independent NASA center. For 13 years it was administered by NASA's Ames Research Center in Moffett Field, California, and designated a facility. Kenneth J. Szalai, formerly deputy director of Ames Research Center for Dryden, was named Dryden director. (*Antelope Valley Press*, Mar 1/94)

February: A feature article on NASA Administrator Daniel S. Goldin and NASA described the Agency's ups and downs over the years. It cited Goldin's mantra "smaller, faster, cheaper" but said NASA's real problems were budgeting, contracting, procurement, and financial accounting systems. The article commended NASA's recent cost estimates as more realistic and referred to Goldin's push to include Russia in the Space Station project as a means of

reducing costs. Stressing the agency's financial management problems, the article pointed out that NASA still lacked a chief financial officer, which Congress required. The article lauded the success of the Hubble rescue mission as a NASA triumph and referred to other Goldin plans such as focusing on Mission to Planet Earth to monitor the Earth's environment and improving aeronautical research. (*Government Executive*, Feb/94)

- NASA's appointment of France Cordova as the Agency's Senior Scientific Adviser, on a three-year leave of absence from Pennsylvania State University was featured. She was to serve as the principal link between NASA and the science community and ensure that NASA programs were regarded as scientifically and technologically well-founded. She was also to coordinate an integrated strategic plan for all the scientific disciplines within NASA. (*The Penn Stater*, Feb/94)

March

March 2: NASA announced the postponement of the launch of Space Shuttle Columbia until March 4 because of a severe storm. (AP, Mar 2/94; Reuters, Mar 2/94; *NY Times*, Mar 3/94; *P Inq*, Mar 3/94; *USA Today*, Mar 3/94)

- Clementine spacecraft, launched January 25 from Vandenberg Air Force Base, California, took just released high-resolution color photographs of the Moon. The purposes of the spacecraft were to test anti-missile military technology and explore space. Reportedly, the pictures, which were available to the public, were of high quality and the cost of the program was relatively low. (Reuters, Mar 2/94; *W Times*, Mar 20/94)

- Businessman James Robertson of James M. Beggs Associates consulting firm of Arlington, Virginia, pleaded guilty to accepting inside bid information involving NASA contracts at Johnson Space Center, Houston. (AP, Mar 2/94)

March 3: NASA announced the selection of a system to control microbial contamination in drinking water as both the NASA 1993 Invention of the Year and the NASA 1993 Commercial Invention of the Year. NASA Johnson Space Center, Houston, Deputy Chief of the Biomedical Operations and Research Branch Richard L. Sauer developed the system together with Gerald V. Colombo and Clifford D. Jolly of Umpqua Research Company, Myrtle Creek, Oregon. The process had applications for long-term space flight as well as commercial use in developing nations particularly. (NASA Release 94-33)

- NASA announced that transmission of data from Galileo spacecraft indicated its observation of what was probably a satellite of the asteroid Ida, which would be the first Moon of an asteroid ever sighted. The flyby of Ida occurred August 28, 1993. (NASA Release 94-34; AP, Mar 4/94)

March 4: Preparations for the launch, the launch itself, and experiments conducted aboard the Space Shuttle Columbia received extensive media coverage. Fueling began the morning of March 4 prior to the crew's boarding. The mission commander and the pilot wore newly devised long johns with tubes that plugged into water pumps to keep them cool while awaiting takeoff and during reentry. Most of the major experiments were to be operated from the ground so that the astronauts could concern themselves with medical tests, some mechanical structures, and observation of the 12 rats used in a bone density study. On March 5, one of Columbia's three auxiliary power units registered an unusually high pressure reading, causing concern; the readings returned to normal when the crew switched to other heaters. It developed that the high pressure apparently resulted from an ice buildup in one of the auxil-

inary power units. Meanwhile, several articles expressed concern that budget cuts endangered the safety of NASA flights, but NASA Administrator Daniel S. Goldin denied this was true. As the space flight progressed, two crew members at a time took turns in taking four hours off duty in view of the lengthy nature of the mission. (*W Post*, Mar 4/94; *AP*, Mar 4/94; *UP*, Mar 4/94; *Reuters*, Mar 4/94; *W Times*, Mar 5/94; *NY Times*, Mar 5/94; *W Post*, Mar 5/94; *B Sun*, Mar 5/94; *P Inq*, Mar 5/94; *W Times*, Mar 6/94; *W Post*, Mar 6/94; *P Inq*, Mar 6/94; *Daily News*, Mar 6/94; *UP*, Mar 6/94; *Reuters*, Mar 6/94; *NY Times*, Mar 7/94; *AP*, Mar 7/94; *UP*, Mar 7/94; *Reuters*, Mar 7/94; *NY Times*, Mar 8/94; *CSM*, Mar 8/94; *W Post*, Mar 8/94; *C Trib*, Mar 8/94; *Reuters*, Mar 8/94; *AP*, Mar 9/94; *UP*, Mar 9/94)

- One of the major experiments conducted on Columbia involved growing crystals, which had many potential commercial and medical applications. However, results to date were not promising and caused criticism of expenditures involved. (*Fla Today*, Mar 4/94)

March 7: NASA announced that the second mission of its Small Expendable-tether Deployer System (SEDS-2) was scheduled for launching from a U.S. Air Force Delta II rocket no sooner than March 9 from Cape Canaveral Air Force Station, Florida. The project was designed to demonstrate an economical way of delivering smaller payloads, such as micro-satellites, to higher orbits. (NASA Release 94-35)

- NASA announced that its Office of Safety and Mission Assurance, Washington, DC, was to receive valuable data from a flight test in June of a new laser-diode initiated ordnance system on Orbital Sciences Corporation's Pegasus air-launch space booster. (The intent is that space flight operations be safer and more efficient than with present electrical systems.) (NASA Release 94-36)

- Following a protest ruling in its favor, Recom Technologies, San Jose, California, received payment for its Computational, Administrative, Professional, and Engineering Services contract with NASA's Lewis Research Center. (*Federal Computer Week*, Mar 7/94)

March 8: NASA announced that it and the Department of Defense had instituted policies to standardize requirements so as to improve the quality of contractor-delivered products to both agencies. (NASA Release 94-37)

- George Brown, Democrat from California and chairman of the House of Representatives Science Committee, told the seven-member Space Shuttle crew that repaired the Hubble Space Telescope in September 1993, that their successful mission would help restore support for the space program. (*Reuters*, Mar 8/94; *B Sun*, Mar 9/94)

- A Federal grand jury indicted Ram Bachan Ram, chairman of the mathematics department at Hampton University, on seven counts of mail fraud related to alleged plagiarism in submitting a proposal for a research grant to NASA. The proposal concerned "Implications of Pressure Diffusion for Shock Waves," and for it Ram received \$100,810 from NASA's Langley Research Center. However, it developed that Ram had stolen the proposal and findings from the work of a professor at Clemson University in South Carolina. (*Virginia Pilot*, Mar 9/94)

March 9: NASA announced the scheduled delivery on March 24 of a Boeing 757-200 aircraft to serve as a "flying laboratory" for aeronautical research. The research was intended to benefit the U.S. aviation industry and commercial airline customers. (NASA Release 94-39)

- NASA announced that Space Shuttle Endeavour was to be launched in April to study Earth's global environment. The Space Radar Laboratory was to consist of the Spaceborne Imaging Radar-C/X-Band Synthetic Aperture Radar and the Measurement of Air Pollution from Satellite. Of these instruments, the German Space Agency (DARA) and the Italian Space Agency (ASI) were to provide the X-Band Synthetic Aperture Radar. An international team of 49 science investigators from 13 nations were to conduct the experiments. In addition, the mission was to include NASA's Get Away Special experiments that allow average persons a chance to perform experiments in space; it was also to be the first cooperative initiative with the National Institutes of Health using a special cell culture system. (NASA Release 94-38)

- An Air Force Delta 2 rocket blasted into orbit carrying the final advanced satellite in the U.S. military's Global Positioning System, Navstar. Delta 2 also carried NASA's experiment to test a space tether 12.5 miles long to determine how long it survived in orbit among space junk. The tether could ultimately be used for various purposes such as generating electricity or changing spacecraft altitudes. (Reuters, Mar 9/94; UP, Mar 9/94; AP, Mar 10/94; *NY Times*, Mar 11/94; *NY Times*, Mar 15/94)

- As the astronauts aboard Space Shuttle Columbia neared and passed the halfway point of their mission, they continued medical and metal research experiments, growth studies with protein crystals, and physical exercises. Lettuce and other seeds flown on Columbia were to be planted after the shuttle returned and then tested. Apart from the desire for a hot shower, the astronauts had no complaints and hoped they might break the U.S. record of time in space flight. The study of spacecraft glow on March 12 experienced difficulty when the ultraviolet light detector malfunctioned. On March 14, the astronauts began tests of a robot arm targeting system. On March 17, the astronauts started packing up experiments in preparation for landing the following day.

Columbia landed uneventfully on March 18, having completed 223 orbits over 5.8 million miles. (Reuters, Mar 9/94; UP, Mar 10/94; AP, Mar 10/94; Reuters, Mar 10/94; Reuters, Mar 11/94; AP, Mar 11/94; UP, Mar 11/94; *B Sun*, Mar 12/94; *W Post*, Mar 12/94; *NY Times*, Mar 12/94; Reuters, Mar 12/94; *W Times*, Mar 12/94; *LA Times*, Mar 13/94; *B Sun*, Mar 13/94; Reuters, Mar 13/94; UP, Mar 13/94; *B Sun*, Mar 14/94; *P Inq*, Mar 14/94; *USA Today*, Mar 14/94; AP, Mar 14/94; UP, Mar 14/94; AP, Mar 15/94; Reuters, Mar 15/94; UP, Mar 15/94; *W Post*, Mar 16/94; AP, Mar 16/94; *C Trib*, Mar 16/94; *USA Today*, Mar 17/94; *W Times*, Mar 17/94; AP, Mar 17/94; UP, Mar 17/94; Reuters, Mar 17/94; UP, Mar 18/94; AP, Mar 18/94; Reuters, Mar 18/94; *B Sun*, Mar 19/94; *NY Times*, Mar 19/94; *W Times*, Mar 19/94; *W Post*, Mar 19/94; *USA Today*, Mar 21/94)

March 10: The government announced that it would allow companies to market sophisticated spy satellite technology worldwide. U.S. firms could build and operate for-profit satellite systems powerful enough to take photographs from 22,300 miles above the Earth and show objects on the ground as small as one square yard. (*NY Times*, Mar 11/94; *USA Today*, Mar 11/94; *W Post*, Mar 11/94; *WSJ*, Mar 11/94)

- NASA Administrator Daniel S. Goldin addressed the National Space Society's conference and challenged the space community to define the U.S. role in space. He expressed frustration at repeated congressional efforts to kill the planned International Space Station. (*Fla Today*, Mar 11/94)

March 13: NASA budget cuts and various problems experienced in recent flights aroused concern for the safety of astronauts, according to NASA critics. Despite assurances by Daniel Mulville, Director of NASA's Engineering and Quality Management Division that standards were not compromised, fears of another Challenger type disaster persisted. (AP, Mar 13/94; *P Inq*, Mar 14/94; *LA Times*, Mar 20/94; *Fla Today*, Mar 24/94)

- Orbital Sciences Corporation launched the Taurus rocket from Vandenberg Air Force Base, California, placing two military satellites into orbit. (*C Trib*, Mar 14/94; *W Post*, Mar 15/94)

- Ten Louisiana colleges were scheduled to benefit from NASA's Experimental Program to Stimulate Competitive Research. They were selected for a three-year award of up to \$500,000, which must be matched by the Louisiana Educational Quality Support Fund. The funds were designed to enable states to develop an academic research enterprise directed toward long-term capability in space science and applications, aeronautical and space research, and technology programs. (*Picayune*, Mar 13/94)

March 14: NASA announced the selection by its NASA-industry team of two engine cycle concepts on which to focus the next three years of propulsion

research for a next-generation supersonic airliner. The two concepts—"mixed flow turbofan" and "FLADE" (fan-on-blade)—were designed to be environmentally compatible and economically practical. (NASA Release 94-41)

- NASA announced the opening of a new, remote ground station in Tidbinbilla, Australia, called the Gamma Ray Observatory (GRO) Remote Terminal System. The station was to receive scientific data from the Compton GRO via a Tracking and Data Relay Satellite that was moved into position over the Indian Ocean. (NASA Release 94-42)
- NASA announced that its Office of Space Communications, Headquarters, Washington, DC, was initiating an opportunity for private industry to conduct experiments of future telecommunications technologies via the Tracking and Data Relay Satellite System (TDRSS). Called the Mobile Satcom TDRSS (MOST) Experiment Program, it was designed to enhance U.S. competitiveness in the global satellite telecommunications area. (NASA Release 94-43)

March 15: Volodymyr Gorbunin, head of Ukraine's space agency, appealed to the West for full space research cooperation to save Ukraine's aeronautics industry from collapse. Gorbunin expressed disappointment that NASA officials had refused to discuss joint space construction at talks in Kiev the following week because Ukraine had not yet signed international agreements on proliferation of advanced rocket technology. (Reuters, Mar 15/94)

- Russia's Interfax news agency reported that the previous week a fire had destroyed a control facility at the Baikonur cosmodrome in Kazakhstan. Experts stated, however, that launches would not be affected. (AP, Mar 15/94)
- NASA Space Shuttle Director Tom Utsman announced NASA's intent to accomplish all major modification work on the Space Shuttle fleet at Rockwell International's facility in Palmdale, California. The decision resulted from expanding requirements associated with the Russian cooperative effort, the ability to support future operations of the International Space Station, and the desire to continue to prelaunch process the Shuttle orbiters for flight at the Kennedy Space Center, Florida. (NASA Release 94-44; *Antelope Valley Daily News*, Mar 16/94; *Antelope Valley Press*, Mar 16/94; *Fla Today*, Mar 19/94; *AvWk*, Mar 21/94)
- Naval Academy graduate Wendy B. Lawrence was scheduled to fly on Space Shuttle Columbia in December. After earning a master's degree in ocean engineering at Massachusetts Institute of Technology, she taught physics at the Naval Academy. (*Capitol*, Mar 15/94)

March 16: Diane Farrar of NASA's Ames Research Center, Moffett Field, California, stated that NASA, the National Oceanic Atmospheric

Administration, and the National Science Foundation were conducting an eight-month airborne study of the Antarctic ozone hole and its possible effects. The study, which was to use high-altitude ER-2 NASA aircraft, was to be based in Hawaii and New Zealand. This was the first NASA-sponsored airborne study of the southern polar region since the 1987 campaign that confirmed chlorofluorocarbons were the primary cause of ozone destruction. (UP, Mar 16/94)

March 17: NASA announced that the System Design Review (SDR) for the International Space Station program was to be held March 23 and 24 at the Johnson Space Center, Houston. The following were to be present: NASA managers and those from the Canadian Space Agency, the European Space Agency, the Italian Space Agency, the Japanese Space Agency, the Russian Space Agency, the prime contractor Boeing, and Tier I subcontractors Rocketdyne and McDonnell Douglas. Randy Brinkley, Space Station Program Manager, said the SDR was scheduled to "lock in the key technical elements of the system as well as the schedule and cost." (NASA Release 94-45)

- NASA announced that in cooperation with the Civil Air Patrol and the Federal Aviation Administration it was hosting a national conference for educators on "Aviation and Space Education: America's Leading Edge" in Norfolk, Virginia, April 6-9. (NASA Release 94-46)

- NASA announced the selection of Kathryn C. Thornton and Catherine G. Coleman for the 16-day Microgravity Laboratory mission scheduled for launch in the fall of 1995 aboard Space Shuttle Columbia. (NASA Release 94-47)

March 18: The United States, Canada, Japan, and the European Partner met in Paris with officials of the Russian Federation for the first time to discuss steps to implement the decision to bring Russia into the Space Station partnership. The resulting joint statement referred to Russia's planned contribution, enhancing Station capabilities, needed changes to the legal framework of the 1988 agreements to include Russia, and a schedule to complete negotiations, beginning with an April meeting. (NASA Editor's Note N94-23)

- NASA's Dryden Flight Research Center's Western Aeronautical Test Range passed a milestone on March 18: the 10,000th mission monitored by the range. In this case it was NASA's F-18 High Alpha Research Vehicle's second flight of the day. (*Antelope Valley Press, Mar 19/94*)

March 19: U.S. Defense Secretary William Perry arrived in Kazakhstan from Russia. On March 20, he visited the formerly super-secret Baikonur space center. He saw a Soyuz space rocket being readied for an unmanned mission to Russia's Mir Space Station and the former Soviet Union's grounded Space

Shuttle rockets. Baikonur had launched more than twice the 453 space launches of Cape Canaveral since 1957. Bob Clarke, a NASA Administrator who accompanied Perry, noted that ground crews for Soyuz-manned flights could prepare the pad for a new launch only six hours after one capsule took off whereas the Cape Canaveral turn-around time was one month. Admiral William Owens, vice chairman of the U.S. Joint Chiefs of Staff, marveled at the workmanship of the welds on the Soyuz rocket being readied. (Reuters, Mar 19/94; AP, Mar 20/94; Reuters, Mar 20/94; *W Post*, Mar 21/94; *NY Times*, Mar 21/94; *Moscow Times*, Mar 22/94)

March 21: Jack Anderson's column concerned the probe by the Office of Special Investigations (OSI) of NASA Inspector General Bill Colvin for alleged serious misconduct. Two OSI investigators reportedly began the probe in late 1992. The investigation centered on whether Colvin had lost the independence necessary for a watchdog by becoming too friendly with NASA executives. (*W Post*, Mar 21/94)

- NASA announced the selection of two Winston-Salem State University faculty members to participate in the NASA/University Joint Venture Program (JOVE). The program enabled faculty and students to become involved in space science research. NASA was to invest \$138,000 over three years to support Winston-Salem State's program participation. As part of the program, two faculty members would spend 10 weeks in the summer of 1994 at NASA Field Centers being "mentored" by NASA scientists. (NASA Release 94-48)

- An Air Force panel was completing the space launch modernization study mandated by Congress; and the White House Office of Science and Technology Policy was preparing recommendations on vehicle developments. The trade *Aviation Week & Space Technology* publication advocated the United States' developing a modern expendable launch vehicle with money both from government and industry. The next step, which would need multi-billion-dollar investment, would require "leapfrog technology" such as the use of propulsion, and could benefit from cooperation with the Commonwealth of Independent States. (*AvWk*, Mar 21/94)

- NASA encountered difficulties in its desire to deliver planetary video data to microcomputer users because of the limitations of the technology. Mike Martin, a science data systems technologist with NASA's Jet Propulsion Laboratory in Pasadena, California, said that so far he and his colleagues had been unable to incorporate Apple QuickTime video into multimedia presentations to run on the Macintosh and multimedia PCs. (*Government Computer News*, Mar 21/94)

March 22: NASA announced that Jack Farmer, a paleontologist and geologist at Ames Research Center, Moffett Field, California, had developed a strategy to search for microfossils on the planet Mars. Farmer presented his strategy,

which was based on principles of Precambrian paleontology, at the Geological Society Meeting of America in San Bernardino, California. (NASA Release 94-49)

- Franklin Chang-Diaz, a Costa Rican immigrant to the United States, addressed the National Hispanic University mathematics and science convocation in San Jose to tell Hispanic students how he became the first Hispanic in space. He flew with the NASA five-person crew with Russian cosmonaut Sergei Krikalev on Shuttle Discovery in February. (*San Jose Mercury News*, Mar 22/94)

March 23: NASA showed photographs taken by Galileo spacecraft revealing for the first time an asteroid orbited by its own moon. NASA's Jet Propulsion Laboratory released the photos of asteroid Ida. (NASA Release 94-50; Reuters, Mar 23/94; *P Inq*, Mar 24/94; *LA Times*, Mar 24/94; *W Post*, Mar 24/94; *USA Today*, Mar 24/94; *NY Times*, Mar 24/94)

- An independent safety review panel said NASA's Space Shuttle fleet urgently needed a safer fuel pump and feared that continued job cuts at Kennedy Space Center would endanger astronauts. The panel also advocated the need for more specific plans to avoid crashing into orbiting "space junk" as well as the need to finalize a quick-escape system for Space Station astronauts. (*H Post*, Mar 24/94)

- A congressional report, based on a House Subcommittee on Space tour of the European and Russian space communities, said Europeans were tired of U.S. changes in the International Space Station project and uncertain about U.S. plans to take Russia in as a full partner. The report also expressed concern about how well Russia could support its part of the Space Station agreement. (*AP*, Mar 23/94)

- NASA announced the signing of a memorandum of understanding with the Commission for Space Activities of the Federative Republic of Brazil (COBAE). The two parties were to conduct a sounding rocket campaign in Brazil from July through October 1994 to investigate the electrodynamics and irregularities in the ionosphere and mesosphere along the Earth's magnetic equator and study their relationship with the neutral atmosphere and winds. NASA was to launch, with the support of COBAE, 33 rockets from the new Brazilian launch range, Centro de Lançamentos de Alcântara in Maranhão. Brazilian scientific participation was to be coordinated by the Instituto Nacional de Pesquisas Espaciais (INPE) and was to be named the Guara Campaign after a bird native to the equatorial region of Brazil. (NASA Release 94-51)

- NASA announced the selection of 55 researchers to receive two-year grants to conduct microgravity research. Annual funding of each proposal was approximately \$50,000, for an overall total of more than \$5.6 million.

Proposals selected were 24 in fluid physics, 26 in materials science, and six in fundamental physics. The goal was to explore new ideas about the influence of gravity on physical and chemical processes that might improve Earth-based production methods and materials. (NASA Release 94-52)

- NASA announced the completion of the International Space Station System Design Review. Using approximately 75 percent of Space Station Freedom hardware, the completed Station was to consist of U.S. elements, including the integrated truss, habitation module, and laboratory module; the Russian science power platform, service module, and functional cargo block vehicle (FGB); the European laboratory module; the Japanese experiment module and exposed facility; and the Canadian remote manipulator system. The assembly was to begin with launch of the FGB vehicle in November 1997. The U.S. contribution to the Station was estimated to cost \$17.4 billion from fiscal year 1994 until assembly was complete in 2002. The ground system for the Station was to build on the Shuttle and Freedom programs. (NASA Release 94-53; *USA Today*, Mar 25/94; *W Times*, Mar 25/94; AP, Mar 25/94; *Antelope Valley Press*, Mar 26/94)

- The Congressional Budget Office (CBO) in its report faulted NASA's effort to fit a program projected in the late 1990s to cost more than \$20 billion a year into an annual budget of \$14 billion. The CBO said such effort risked delay and failure, and the CBO offered the alternative of grounding the astronauts and ending the Space Shuttle program. Specifically, the report proposed one of the following: ending costly piloted space flight, concentrating instead on robot aircraft and new technology for industry; emphasizing a roboting spacecraft and conducting only four instead of eight Space Shuttle flights a year; concentrating on piloted space flight, building the Space Station and planning for manned missions to the Moon and Mars, limiting robot missions to pathfinder projects for the Moon-Mars effort. NASA Administrator Daniel S. Goldin said NASA would not back away from the administration's balanced aeronautics and space program. He added that any of the three CBO alternatives would destroy that balance and that NASA could accomplish daring and difficult missions on a tight budget. (NASA Editor's Note N94-27; *B Sun*, Mar 25/94; *W Times*, Mar 25/94; *P Inq*, Mar 25/94; *NY Times*, Mar 25/94; *O Sen Star*, Mar 25/94; *W Post*, Mar 25/94; AP, Mar 25/94; *LA Daily News*, Mar 27/94; *Federal Computer Week*, Mar 28/94; *O Sen Star*, Mar 31/94)

- James Sensenbrenner, Republican from Wisconsin, and ranking member of the House Space Subcommittee, wrote NASA Administrator Daniel S. Goldin requesting information about U.S. dependence on Russia, payments to the Russian government, cost constraints on the Space Station in view of NASA's tight budget, and financial agreements with Station international partners. He expressed reservations over the decision to move the Station to a higher orbital inclination at the Russian request and expressed the fear that

the agreement with Russia was negotiated from a position of U.S. vulnerability because of budgetary limits. (*Defense Daily*, Apr 1/94)

March 24: Six astronauts went through a countdown drill aboard Shuttle Endeavour, and NASA set the date of April 7 for the spaceship's launch on an environmental research mission. (Reuters, Mar 24/94)

- An unmanned cargo craft bearing food, fuel, and equipment docked with Russia's Mir Space Station according to Itar-Tass news agency. (Reuters, Mar 24/94)

March 25: Former NASA Space Station Director Richard Kohrs was a member of a team to revamp the Cassini mission for NASA's Jet Propulsion Laboratory. NASA Administrator Daniel S. Goldin also contacted him, reportedly asking that he look at the troubled Space Station program. (*SP News*, Mar 28-Apr 3/94)

- Eric Glomboske, an 11th grader at Highland High School, was one of 10 regional winners in the NASA-sponsored Space Science Student Involvement Program. To compete, Eric designed, planned, and mapped out a human journey to Mars. (*Antelope Valley Press*, Mar 25/94)

March 28: GOES-8, a sophisticated weather satellite, was the first of five advanced GOES-NEXT satellites scheduled to be deployed by 2003. The National Oceanic and Atmospheric Administration managed the GOES program but engineers at NASA's Goddard Space Flight Center oversaw development of the spacecraft. These engineers redesigned weather instruments used by polar-orbiting weather satellites that flew 500 miles high to operate instead at 22,300 miles high. The system had vast potential benefit for firefighters, farmers, marine and aviation navigators, and others through improving the accuracy of weather forecasting. (*W Post*, Mar 28/94)

- In connection with its April mission, Space Shuttle Endeavour was to carry a radar imaging experiment that would collect data on surface texture in several areas of the globe, including California's Mojave Desert and Death Valley. The movement of sand was determined by a complex interrelationship among wind velocity, wind intensity, and the surface texture of the ground. Diane Evans, a geologist at NASA's Jet Propulsion Laboratory in Pasadena, California, explained that if the experiment works well it might become a permanent part of NASA's comprehensive study of global change. The experiment also was to study vegetation around the world; in order to see as much of the Earth as possible, the Endeavour was to be launched on a trajectory that would cover most of the globe, with the orbit ranging from 57 degrees north of the equator to 57 degrees south. (*LA Times*, Mar 28/94)

- Russia inherited the Soviet Union's ambitions in space but lacked its main launch pads. Russian President Boris Yeltsin in a visit to his Kazakh counterpart, Nursultan Nazarbayev, hoped to sign a 30-year lease on the Baikonur Cosmodrome. The outcome was a 20-year lease with an option to renew for 10 more years, and an annual payment of about \$115 million. However, should this effort prove unsuccessful, Russia was developing other sites. Russian space scientists considered the Plesetsk Cosmodrome in the far north unsuitable for manned flights, but Colonel General Vladimir Ivanov told the Itar-Tass news agency that Russia planned to build a major new space center in the far east at Svobodny, north of Blagoveshchensk. (*LA Times*, Mar 28/94; Reuters, Mar 28/94; *W Post*, Mar 29/94)

- George Brown, Democrat from California, chairman of the House Science Committee, sent a letter to NASA Administrator Daniel S. Goldin asking that NASA develop cost estimates for upgrading the infrastructure surrounding Russia's Baikonur Cosmodrome. He also requested that NASA explore options for establishing direct relations with Kazakhstan in the areas of science and technology. (*Defense Daily*, Apr 1/94)

March 29: Douglas B. Shaffer, president of Astro International Corporation, and Kenneth E. Smith, the company's director of NASA programs, pleaded guilty to soliciting and accepting inside information on a \$3.3 million NASA contract. The company also pleaded guilty. (AP, Mar 29/94)

March 30: NASA announced the development at NASA's Ames Research Center, Moffett Field, California, of a new tile known as Toughened Uni-Piece Fibrous Insulation (TUFI). The low-density composite thermal insulation was to undergo its first flight test on the Endeavour in April. (NASA Release 94-54)

- Thomas D. Jones was one of the astronauts scheduled to fly on the Endeavour. Since boyhood he always wanted both to fly and to study science. (*B Sun*, Mar 30/94)

- India signed a new agreement to buy seven rocket engines from Russia's commercial space organization, according to U.R. Rao, outgoing head of the Indian Space Research Organisation. The first engine was to be delivered in 1996 and the remainder over a three-year period. (Reuters, Mar 30/94)

March 31: NASA announced that the first cooperative space flight research between NASA and the National Institutes of Health (NIH) was intended to help scientists better understand the effects of microgravity on the growth of human bone and muscle cells during space flight. It might also increase understanding of changes in muscle and bone on Earth after severe injury, certain degenerative diseases, or prolonged bedrest. This research was to be a part of the April Space Shuttle mission. (NASA Release 94-55)

- NASA Administrator Daniel S. Goldin paid a 90-minute visit to Rocketdyne's main factory in Canoga Park, California. He said the company had made some progress in correcting quality control problems that caused two Shuttle launches to be aborted seconds before liftoff and two other scheduled flights to be postponed. (*LA Times*, Apr 1/94)

March/April: The Space Shuttle crew that repaired the \$1.6 billion Hubble Space Telescope were commended for their work, which enabled the view of stars 10 times as faint as previously. The instrument more than doubled the telescope's previous range. (*Life Magazine*, Mar/Apr/94)

April

April 1: Abe Martinez, assistant U.S. attorney in Houston, said that one corporation and eight individuals, including a NASA contracting officer, Stephen Cleland, had pleaded guilty to criminal charges in connection with Operation Lightning Strike at NASA's Johnson Space Center. The U.S. attorney's office was to ask a grand jury to indict another Johnson official, David Proctor. (*SP News*, Apr 4-10/94)

April 4: NASA announced the rescheduling of the launch of Space Shuttle Endeavour to April 8 to allow further inspections of metallic vanes in the high pressure oxidizer preburner pump volute housings of its main engines. (NASA Release 94-028; AP, Apr 4/94; UP, Apr 4/94; Reuters, Apr 4/94; *P Inq*, Apr 5/94; *W Times*, Apr 5/94; *USA Today*, Apr 5/94)

- Laurie Boeder, NASA Associate Administrator for Public Affairs, discussed NASA's struggles to fund NASA Select, a television channel that covered Space Shuttle missions for broadcast on cable and use by commercial networks. (*SP News*, Apr 4-10/94)

- Sidney Gutierrez was featured as making history because he was the first Hispanic to command a spacecraft. Scheduled to command the Endeavour on its April flight he said he was happy if he could serve as a role model for young people. (*H Post*, Apr 4/94)

April 5: A joint statement was issued following a meeting of the heads of space agencies involved in the International Space Station: the Canadian Space Agency (CSA), the European Space Agency (ESA), the National Space Development Agency of Japan (NASDA), the Russian Space Agency (RSA), and NASA. This was the first group meeting since Russia accepted the collective invitation to join the International Space Station partnership in December 1993. The heads of agencies discussed the outcome of the recently completed Space Station System Design Review. CSA, ESA, and NASDA noted the remarkable progress made to accommodate Russia as a new partner and to satisfy the interests of all the partners in the new program structure, and they commended NASA for its efforts to improve program efficiency and to clarify the potential for additional partner contributions.

Activities at the government and agency levels have paved the way for negotiation of the agreements necessary to formalize Russia's inclusion in the program. All expressed support for proceeding with these negotiations, scheduled to start in late April, in an expeditious manner. The heads of agencies also noted the importance of concluding, in a timely manner, the interim

agreement between NASA and RSA to facilitate Russia's early participation in program management mechanisms. (NASA Editor's Note N94-28)

- NASA announced its intent to grant the Arkansas Aerospace Education Center \$500,000 to implement its Technology Industry Resource Project to help develop enrichment opportunities for secondary school students statewide in mathematics, applied sciences, and technology. (NASA Release 94-56)
- NASA announced the departure from NASA, effective April 11, of Space Shuttle astronaut Ronald J. Grabe. He was to become vice president of business development for Orbital Sciences Corporation's Launch Systems Group. (NASA Release 94-57)
- NASA found no defects in Endeavour's three pumps during its inspection and cleared the spacecraft for launching on April 8, weather permitting. (AP, Apr 5/94; UP, Apr 5/94; Reuters, Apr 5/94; *W Times*, Apr 6/94; AP, Apr 6/94; UP, Apr 6/94; Reuters, Apr 6/94; *NY Times*, Apr 7/94; *W Post*, Apr 7/94; *USA Today*, Apr 7/94; *W Times*, Apr 7/94)
- A study released by the Virginia-based Teal space consulting group said that since the space age began, 271 missions have failed or malfunctioned. Of the 271 missions, 108 were considered failures and of these, two-thirds or an estimated 71 were Soviet. The remaining 34 failures were American. The most failure-prone spacecraft over the period appeared to be the Soviet-made Cosmos satellite. (Reuters, Apr 5/94)
- Russian Military Space Forces official Sergei Gorbunov said that Russia had decided to develop a new giant booster rocket that was to have a reusable first stage and burn a special, safer low-pollution fuel mixture. The rocket, Angara-24, would be appropriate for a new far eastern launch site if Russia decided to build it as an alternative to the Baikonur Cosmodrome in Kazakhstan. The booster was to be tested in 1998 and the first launch was planned for 2000. (Reuters, Apr 5/94)
- Gregory Reck, Acting Associate Administrator of NASA's Office of Advanced Concepts and Technology (OACT), said that NASA had tasked an industry team with reviewing the direction of its research and development (R&D) efforts in space communications technologies. The group, which was to be composed of satellite manufacturers such as Hughes and Space Systems/Loral, ground station builders like Harris Corporation, and small aerospace firms like Orbital Sciences Corporation, was to identify future space-based systems, both in low-Earth and geosynchronous orbits, and how they might tie into the National Information Infrastructure. NASA's role in the activity was to be directed by Samuel Venneri, head of spacecraft and

remote sensing in OACT. The consensus findings of the team were to be used in relation to NASA fiscal year budgets. According to the NASA officials, the key motivation behind the initiative was to minimize inroads by European and Japanese competitors into the 60 percent market share held by U.S. firms in satellite communications. (*Defense Daily*, Apr 7/94)

April 6: Lieutenant Colonel Tom Akers, an astronaut, presented NASA's \$500,000 check to the state of Arkansas's Aerospace Education Center. (*Arkansas Democrat Gazette*, Apr 6/94; *Fla Today*, Apr 17/94)

- NASA Administrator Daniel S. Goldin said he personally would discuss the Space Station program with 220 members of Congress before the House of Representatives votes on the Station in the summer. (*SP News*, Apr 11-17/94; *AvWk*, Apr 11/94)

- Kenneth J. Szalai, Director of NASA's Dryden Flight Research Center, received the Distinguished Executive Presidential Rank Award. (*Antelope Valley Press*, Apr 6/94)

April 7: Jack Anderson's column reported that Margaret Barnes, a NASA employee, sent a confidential letter to Senator John Glenn, Democrat of Ohio, on September 2, 1993, alleging among other things, that women in NASA Inspector General Bill D. Colvin's office were treated like "second-class citizens." Barnes was called in and berated by Colvin who had a copy of the letter, which was apparently leaked by Glenn's office. NASA sources said GAO had added the Barnes/Glenn episode to its investigation of Colvin. (*W Post*, Apr 7/94)

- NASA announced the selection of 39 researchers to receive three- to four-year grants for microgravity combustion research totaling more than \$13 million. Of the grants, 33 were for Earth ground-based research and six for flight definition efforts. (NASA Release 94-58)

- NASA spokesperson Bruce Buckingham at Kennedy Space Center said the tether launched by the Space Shuttle was working well. It could be used to move satellites around in different orbits in space. Originally about 12 miles long, atomic oxygen and tiny meteorites ate it so that it was now only about five miles long. (*O Sen Star*, Apr 7/94)

- The International Federation of Professional and Technical Engineers filed unfair labor practice charges against NASA because of the April 4 memorandum from Jeremiah Pearson, Associate Administrator for Space Flight, transferring several positions from headquarters to Johnson Space Center and Kennedy Space Center without collective bargaining. (*SP News*, Apr 11-17/94)

April 8: NASA Administrator Daniel S. Goldin addressed the University of Arizona's Open Sciences Forum at which professors presented overviews of their space-related work. He assured the faculty and students that NASA would continue to fund University of Arizona research projects such as the \$3.6 billion Cassini Saturn probe. He urged scientists to simplify the way in which they discuss their experiments so that lay people would understand them and thus increase scientific awareness. Stressing the concept that "small is better," he mentioned the development of robots that may one day extract fuel from the Moon or Mars, thus reducing the amount of propellant that would need to be stored on Moon- or Mars-bound spacecraft. (*Tucson Citizen*, Apr 9/94)

- In a telephone interview, NASA Administrator Daniel S. Goldin, who was formerly general manager of TRW's Space and Technology Group in Redondo Beach, California, answered questions about NASA and his efforts to revive the Agency. Among other topics, he discussed the International Space Station, the difficulties of working in space, and the problems of budget cuts that NASA faced. (*Orange County Register*, Apr 8/94)

April 9: Space Shuttle Endeavour, which had been rescheduled to lift off on April 8, was launched April 9 because of bad weather. In its cargo bay was the Space Radar Laboratory, weighing 23,000 pounds and containing \$366 million worth of imaging systems. The system was to bounce radar waves off Earth in three frequency bands to produce three-dimensional maps of ocean currents, river valleys, forests and farm lands, the geology of volcanoes, and features under desert sands. NASA's Jet Propulsion Laboratory in Pasadena, California, and the German and Italian space agencies developed the equipment. The radar developed a glitch after the first day, but ground control was able to repair it and the results were most successful. (*NY Times*, Apr 8/94; *W Post*, Apr 8/94; *B Sun*, Apr 8/94; *Reuters*, Apr 8/94; *USA Today*, Apr 8/94; *AP*, Apr 8/94; *UP*, Apr 8/94; *Reuters*, Apr 9/94; *AP*, Apr 9/94; *W Post*, Apr 10/94; *NY Times*, Apr 10/94; *B Sun*, Apr 10/94; *P Inq*, Apr 10/94; *UPI*, Apr 10/94; *Reuters*, Apr 10/94; *AP*, Apr 11/94)

- NASA researchers were to go underground on April 11 in Lechuguilla Cave in Carlsbad Caverns National Park in New Mexico to try to replicate conditions on Mars. NASA engineer Larry Lemke was mainly interested in the technology aspect of developing robots to collect the microorganisms in Lechuguilla if it proved a useful source. NASA planetary scientist Chris McKay and contract microbiologist Penny Boston wanted to see if microorganisms living inside Lechuguilla could reveal life that might exist on Mars. Bacteria in the cave get their energy from sulfur and iron, believed to be two main ingredients of Mars's soil. Samples taken during the five-day underground stay that ended on April 16 were to be analyzed at the U.S. Geological Survey laboratory in Denver, a NASA-contracted laboratory in Boulder,

Colorado, and the University of Massachusetts at Amherst. (AP, Apr 9/94; AP, Apr 13/94; AP, Apr 18/94)

April 11: Astronaut Tom Jones on Space Shuttle Endeavour answered questions about radar mapping and the Earth's ozone layer from students at his former school in Stemmers Run, Maryland. Among the areas Endeavour radar was mapping were traces of ancient rivers beneath the Sahara Desert. Other areas being targeted for mapping were the Andes and the East Australian Current as well as fires in China south of the Yellow River and flooding in the Midwest. Astronauts assured C-SPAN television questioners that the mapping radar was strictly for scientific not military purposes. At the halfway point of the mission, NASA said Endeavour already had collected 95 percent of the data it was to gather. The astronauts were divided into two shifts of three persons each in order to work round the clock monitoring radar performance, taking pictures of the Earth, and recording observations on tape. An air pollution monitor aboard Endeavour found surprisingly high levels of carbon monoxide in the Northern Hemisphere, according to NASA. NASA scientists on the ground were delighted with the quality of pictures and other data beamed by radar.

As part of their preparations for returning to Earth on April 19, the astronauts test-fired their steering jets and wiggled their flaps on April 17. On April 18, Endeavour took radar pictures of 19,300 square miles of north China from 140 miles up in space. Meanwhile, according to the official Xinhua News Agency, Chinese remote-sensing aircraft at 3.7 miles up used radar and a mobile microwave scatter meter and surveyors on the ground also joined in. The astronauts then began to stow away equipment and turn off radars in preparation for landing. Because of adverse weather conditions April 19, Endeavour was unable to land until April 20 and was diverted to Edwards Air Force Base, California. (UP, Apr 11/94; Reuters, Apr 11/94; *B Sun*, Apr 12/94; *USA Today*, Apr 12/94; *Fla Today*, Apr 12/94; *O Sen Star*, Apr 12/94; *H Chron*, Apr 12/94; AP, Apr 12/94; UP, Apr 12/94; *W Post*, Apr 13/94; *H Chron*, Apr 13/94; *H Post*, Apr 13/94; *USA Today*, Apr 14/94; *Fla Today*, Apr 14/94; Reuters, Apr 14/94; UP, Apr 14/94; *USA Today*, Apr 15/94; *H Chron*, Apr 15/94; AP, Apr 15/94; *C Trib*, Apr 16/94; *W Times*, Apr 16/94; UP, Apr 16/94; AP, Apr 16/94; *W Times*, Apr 17/94; UP, Apr 17/94; *P Inq*, Apr 18/94; *CSM*, Apr 18/94; *USA Today*, Apr 18/94; AP, Apr 18/94; UP, Apr 18/94; Reuters, Apr 18/94; *USA Today*, Apr 19/94; AP, Apr 19/94; Reuters, Apr 19/94; *H Post*, Apr 20/94; *H Chron*, Apr 20/94; AP, Apr 20/94; UP, Apr 20/94; Reuters, Apr 20/94; *NY Times*, Apr 21/94; *W Post*, Apr 21/94; *W Times*, Apr 21/94; *USA Today*, Apr 21/94; *B Sun*, Apr 21/94; *C Trib*, Apr 21/94; AP, Apr 21/94)

- Although NASA as yet lacked congressional approval for a proposed \$2 billion wind tunnel complex for testing commercial aircraft, California's congressional delegation lobbied NASA's Administrator Daniel S. Goldin to have the wind tunnel built in California at NASA's Ames Research Center in

Moffett Field. Goldin refused to discuss the subject. Virginia also expressed interest in being a site for the wind tunnels, according to Representative Robert C. Scott. (*LA Times*, Apr 12/94; *SF Chron*, Apr 12/94; *San Jose Mercury News*, Apr 12/94; *LA Times*, Apr 12/94; *Daily Press*, Apr 20/94)

- Harry Holloway, Associate Administrator for NASA's Office of Life and Microgravity Sciences and Applications, stressed that both the Spacelab and Mir were critical elements in NASA's orbital research program. During the next three years, NASA was scheduled to fly four Spacelab missions and five of the scheduled 10 Shuttle flights to Mir were to use the long Spacelab module to conduct priority research in fluid physics and combustion. (*SP News*, Apr 11-17/94)

- Arthur F. Obenschain, project manager for NASA's Goddard Space Flight Center in Greenbelt, Maryland, had overseen construction of the Geostationary Operational Environmental Satellite (GOES) weather spacecraft. He reported that all previous major technical problems had been overcome and that the first of the GOES was scheduled for launch from Cape Canaveral on behalf of the National Oceanic and Atmospheric Administration on April 13. Launched on schedule, GOES was predicted to provide more accurate tracking of hurricanes and other storms than did previous weather spacecraft. (*NY Times*, Apr 12/94; *Fla Today*, Apr 12/94; *H Chron*, Apr 12/94; AP, Apr 13/94; *USA Today*, Apr 14/94; *W Post*, Apr 14/94; *NY Times*, Apr 14/94; *Plain Dealer*, Apr 14/94)

- As part of the administration's efforts to gain congressional support for NASA's International Space Station project, NASA was considering removal of the Russian Salyut Functional Cargo Block (FCB) vehicle from the redesigned configuration. If the FCB were removed, which some key members of Congress wanted in order to reduce dependence upon Russia, NASA might replace it with Lockheed's Bus-1. Following the March International Space Station System Design Review, international partners and White House advisers, including members of the presidential panel reviewed the Station redesign and, in general, seemed favorably disposed to the Station. The panel was headed by Charles Vest, president of the Massachusetts Institute of Technology. (*AvWk*, Apr 11/94)

- NASA in a cooperative agreement notice called on third parties to develop public-use applications of its remote sensing databases in order to make use of the reams of Earth and space science data collected to date. Paul Hunter, Program Manager for NASA's Information Infrastructure Technology Applications program, said NASA planned to grant about 8 to 10 large awards of \$500,000 to \$1.5 million per year, and eight to 20 smaller awards of about \$100,000 to \$300,000. (*Federal Computer Week*, Apr 11/94)

April 12: NASA announced the signing on April 7 of a technology reinvestment program agreement to develop hybrid rocket motor technology between NASA's Marshall Space Flight Center, Huntsville, Alabama, and a consortium of three U.S. aerospace companies. The firms consisted of Martin Marietta Manned Space Systems, New Orleans; United Technologies Corporation's Chemical Systems Division, San Jose, California; and the American Rocket Company, Ventura, California. (NASA Release 94-59)

- Russia marked its Space Day in a subdued mood, with the Baikonur Cosmodrome having become part of Kazakhstan and Russia's cosmonaut team decreased from 100 to 40 people. The Buran Space Shuttle was ended after its only unmanned test flight in 1988. But workers remaining at the Molniya complex in northwestern Moscow, established to construct Buran, hoped to work on the MAKS project involving small shuttles launched from the giant An-225 Mriya transport plane to carry cargo into space. (AP, Apr 12/94)
- Lockheed Corporation in Calabasas, California, and Rocketdyne, the Canoga Park division of Rockwell International, teamed up to compete with other aerospace companies for \$167 million in grants from NASA over the next five years to explore the feasibility of a "single-stage-to-orbit" (SSTO) rocket. It was uncertain whether the White House and the Pentagon favored such a plan, which NASA considered a cost-saving alternative to updating current rockets. (LA Times, Apr 12/94)

April 13: NASA Administrator Daniel S. Goldin told the House Space Subcommittee that the Space Station program was proceeding but cost and schedule savings were decreasing. NASA earlier estimated Russian participation would save two years and \$2 billion. After the Systems Design Review, it appeared time would be speeded by 15 months and savings probably would be \$1.5 billion. Also, Russia now wanted \$650 million instead of \$400 million for lease of the functional cargo block vehicle. Furthermore, agreement needed to be reached with Russia on the cost of a major component required to provide navigation and reboost capability for the Station. NASA assured the Committee that the Agency would never cede control of the Station to Russian ground commanders. Goldin also said it was essential for NASA to have stable funding. (Reuters, Apr 13/94; Defense Daily, Apr 14/94; O Sen Star, Apr 14/94; H Post, Apr 14/94)

- China recently suffered a fire at its Xichang Long March launch facility, damaging a Fengyun II weather satellite and adjacent work areas. (Defense Daily, Apr 14/94)
- NASA Associate Administrator for Space Science told the NASA Advisory Council that NASA wanted to launch one Discovery mission every 12 to 15 months on a Delta or smaller expendable launch vehicle (ELV).

NASA's Goddard Space Flight Center planned to issue a competitive procurement later in the year for up to 15 ELVs, paying \$25 million to \$30 million per vehicle. (*Defense Daily*, Apr 14/94)

April 14: NASA announced that, on April 28, 100 girls, ages 9 to 15, were to join the NASA Headquarters workforce as part of National Bring Your Daughters to Work Day. (NASA Release 94-60; AP, Apr 20/94)

- Representative Ralph Hall, Democrat from Texas and chairman of the Space Subcommittee of the House Committee on Science, Space, and Technology, said he was not sure the President was doing enough to prevent defections among Space Station supporters. Representative George Brown, Democrat from California and chair of the parent committee, threatened to withdraw his support if the President could not get sufficient funds for other science projects. (*H Chron*, Apr 15/94; *National Journal*, Apr 23/94)

April 16: On April 9-10, radio astronomy experts from Stanford University and NASA's Jet Propulsion Laboratory in Pasadena sent a signal from the Clementine spacecraft, which was engaged in a Moon-mapping mission for the Pentagon, into a huge crater on the lunar South Pole. NASA's Deep Space Network picked up the reflection of the signal, and the Pentagon was scheduled to undertake a preliminary review of the data to determine whether the Moon contained ice. (AP, Apr 16/94)

April 18: NASA announced the updated schedule of Space Shuttle/Space Station missions through calendar year 1997 and expendable launch vehicle missions through calendar year 2001. Included were 10 Space Shuttle flights to Russian Space Station Mir between 1995 and 1997. (NASA Release 94-61)

- The six pilots at NASA's Dryden Flight Research Center at Edwards Air Force Base believed that they had the best flying job in the world. Their work entailed a great deal of variety, flying in different types of planes and conducting numerous research experiments. (*Antelope Valley Daily News*, Apr 18/94)

April 19: NASA announced the selection of Praxair, Inc., of Danbury, Connecticut, and Air Products and Chemicals, Inc., of Allentown, Pennsylvania, for 15-year contracts to supply liquid hydrogen to government and contractor facilities. (NASA Release C94-j)

- A House Natural Resources subcommittee sought to get the Interior Department out of the helium business and limit losses to the U.S. Treasury. The greatest government demand for helium was from NASA, and by law government agencies must buy helium from the Bureau of Mines. Congress sought to end government participation in the sale of helium. (AP, Apr 19/94)

April 20: NASA announced that it and the Federal Emergency Management Agency were exploring a cooperative venture to test and implement a prototype remote sensing system that was to acquire, process, and distribute photographic-like digital images of disaster-damaged areas to response and recovery officials in near-real time. (NASA Release 94-62)

- NASA's Jet Propulsion Laboratory, Pasadena, California, announced the award of a grant to Sierra College, Rocklin, California, for a hands-on community college engineering curriculum as part of the government's technology reinvestment project. (NASA Release 94-63)

- NASA announced the development by the Ames Fatigue Countermeasures Program of a training course that taught pilots steps to be used against fatigue. The first workshop was to be held at NASA's Ames Research Center, Moffett Field, California, on May 18-19. (NASA Release 94-64)

- NASA faced tough opposition over Russian participation in the International Space Station during hearings of the House Subcommittee on Space. Both committee chairman Ralph Hall, Democrat from Texas, and James Sensenbrenner, Republican from Wisconsin and ranking Republican member, believed strongly that it should be an American Station. (*O Sen Star*, Apr 21/94)

April 21: NASA announced that a small quantity of nitrogen tetroxide (N₂O₄) was accidentally released from the Thermochemical Test Area at the Johnson Space Center, Houston, during a test setup. The resulting cloud of N₂O₄ gradually dissipated, but area traffic was halted briefly and some 46 people were treated in local medical facilities for mild respiratory symptoms. Nitrogen tetroxide is an oxidizer used in some rocket engines. (NASA Release 94-030; AP, Apr 21/94; Reuters, Apr 21/94; *H Chron*, Apr 22/94; *NY Times*, Apr 22/94; *W Post*, Apr 22/94; *USA Today*, Apr 22/94; UP, Apr 22/94)

- Flight tests of the X-31 at NASA's Dryden Flight Research Center at Edwards Air Force Base were featured. Dryden Director Kenneth J. Szalai noted that the X-31 had completed more flights than any other experimental aircraft, demonstrating methods of enhancing fighter maneuverability. Gary Trippensee was NASA project manager and director of the International Test Organization that included the Department of Defense's Advanced Research Projects Agency, the Navy, Air Force, Rockwell Aerospace, the German government, and Deutsche Aerospace. The program focused on technology transfer—industrial use of data gathered during government research projects. (*Antelope Valley Press*, Apr 21/94; *Bakersfield Californian*, Apr 21/94)

April 22: NASA announced that some 50 U.S., Canadian, and European scientists had begun the second phase of a detailed ecological study of the forests

of Canada and the role these forests played in climate change. The Boreal Ecosystem-Atmosphere Study (BOREAS) was a large-scale, ground-based, and remote-sensing investigation of the way the forests and the atmosphere exchange energy, heat, water, carbon dioxide, and other trace gases. From April 11 to May 2, scientists were to study the forests during the annual snowmelt. The Focused Field Campaign-Thaw, the second of five parts of BOREAS, was to build on spaceborne data resulting from the first flight of the Space Radar Laboratory (SRL) aboard Space Shuttle Endeavour. BOREAS and SRL formed part of NASA's Mission to Planet Earth. (NASA Release 94-65)

- Astronomer Alexander Wolszczan at Pennsylvania State University in an article published in *Science* magazine, claimed "irrefutable evidence" of at least two planets orbiting a nearby star—the first confirmed observation of planets outside the Earth's solar system. The planets were in orbit around an unusual neutron star located 1,200 light-years away in the constellation Virgo. Various NASA staff members commented on the discovery. Robert Millis, director of the Lowell Observatory, Flagstaff, Arizona, said NASA had a major effort underway to search for planets around stars but its program focused on ordinary stars like the Sun. (*LA Times*, Apr 22/94; *USA Today*, Apr 22/94; *P Inq*, Apr 22/94; *W Post*, Apr 22/94; *NY Times*, Apr 22/94)

- NASA's inspector general in a report published in February indicated that an audit showed that astronauts flew two-seater supersonic training jets, T-38 Talons, to Colorado Springs on weekends during ski season as well as to New Orleans and Fort Lauderdale, Florida. NASA required astronauts to log 15 hours of proficiency flying each month. Steve Holly, NASA Deputy Director for Flight Crew Operations, said although flying 10 to 12 hours a day was efficient in a time management sense, improved proficiency was gained through more shorter flights. (*NY Times*, Apr 24/94; *B Sun*, Apr 24/94; *UP*, Apr 25/94)

- In discussing the role of the South Pole Infrared Explorer (SPIREX), and two other projects operated by the National Science Foundation's Center for Astrophysical Research in Antarctica (CARA), a comparison was made of the way in which work from the South Pole on the ground resembled work of the Hubble Telescope in space. The astronomers involved, together with those at the Johns Hopkins University and the Space Telescope Institute in Baltimore were seeking NASA support for a design and cost study of a balloon that would float 40,000 feet above the South Pole and carry a powerful telescope. (*AP*, Apr 22/94)

April 25: Jack Anderson's column indicated that the ties of Isadore Hyde, convicted in 1993 of defrauding the Federal government, to Senator Trent Lott, Democrat from Mississippi, were investigated by NASA officials among others. Hyde's company received a contract in 1984 to provide security services at the Stennis Space Center in Mississippi, and diverted more than \$186,000

for personal use. Former Hyde employees alleged that Hyde used NASA resources to do political favors for Lott and put Lott's mother, who was 71 at the time, on the company's payroll. (*W Post*, Apr 25/94)

- Some 20 students in the Student Rocket Program at the University of Alaska, Fairbanks, built a rocket from scratch over the preceding year and a half. The rocket was to be launched when NASA radar technicians came to Poker Flat for other planned launches. NASA and other U.S. government agencies invested millions of dollars to upgrade 25-year-old Poker Flat, the world's only university-owned rocket range, which had an excellent far northern location. The objective of the rocket flight was technical performance: to get the \$20,000 rocket into the Earth's stratosphere and to keep in contact with it during its brief flight by satellite-relayed signals. (*AP*, Apr 25/94)
- NASA Administrator Daniel S. Goldin spoke to workers at Martin Marietta Manned Space Systems in eastern New Orleans, praising the company's new contract with NASA to make lightweight Space Shuttle external fuel tanks, calling the tanks an essential part of the Space Station. (*Times-Picayune*, Apr 26/94)
- NASA was to award a Program Information System Mission Services (PrISMS) contract worth up to \$800 million by May 1. Three companies were seeking to win the eight-year Marshall Space Flight Center contract: Computer Sciences Corporation, Harris Corporation, and incumbent Boeing Computer Services, Inc. The winning PrISMS vendor was to manage NASA-wide communications, provide some NASA-wide information management services, and run extensive computational services at Marshall. PrISMS had a two-year base with six one-year options; 10 percent of the work was to be set aside for small, disadvantaged businesses. (*Federal Computer Week*, Apr 25/94)
- The launching of GOES-1 on April 13 opened a new era for the National Weather Service's (NWS) Modernization Program. GOES was not the only NWS program to experience trouble because the Next-Generation Weather Radar (Nexrad) also had technical problems but according to Randolph Hite, assistant director in the General Accounting Office's Accounting and Information Management Division, was now working well. More accurate forecasts could now be made further in advance. (*Federal Computer Week*, Apr 25/94)

April 26: Reporting on Spacecraft Clementine, an \$80 million joint military-civilian venture, which sent the first close-up pictures of the Moon in more than 20 years, the mission was considered a possible model for NASA. On May 3, Clementine's rocket was to be fired to leave lunar orbit and head for a rendezvous at the end of August with a small asteroid, 1620 Geographos. Soon thereafter, Clementine might disappear from view; hence the name. Meanwhile, Eugene M. Shoemaker, Clementine's chief scientist and a planetary geologist assigned by NASA, was studying pictures sent by the spacecraft,

including the possible existence of ice at the lunar poles. The mission was considered an example of a "cheaper, faster, better" approach that could pay off. (*NY Times*, Apr 26/94)

- China's space agency said that the April 2 blast that killed one person and injured 20 would not delay the launching of three foreign communications satellites from the Xichang Satellite Launching Center in southwestern China. The three satellites were manufactured by Hughes Space and Communications Company for Hong Kong and Australian customers. (*NY Times*, Apr 27/94)

- Paul F. Holloway, Director of NASA's Langley Research Center, said the Center had no desire to serve as a site for the two new wind tunnels. The Center feared its existing research would suffer if the new structures were located there. California, West Virginia, Tennessee, and Washington were vying as wind tunnel sites. (*Daily Press*, Apr 27/94)

April 27: The U.S. company Space Express Corporation planned to build a rocket launch site in northern Germany to send satellites into space, according to *Stern* magazine. Richard Coleman, head of the Washington, DC-based company, discussed the project with NASA. (UP, Apr 27/94)

April 28: NASA announced a number of personnel changes in the Office of Space Flight (OSF) at NASA Headquarters in Washington, DC. These included the appointment of Bryan O'Connor, currently OSF Deputy Associate Administrator, to assume the post of Space Shuttle Program Director. O'Connor's position was to be assumed by Richard Wisniewski, who retired from NASA in 1990 after 35 years of government service. (NASA Release 94-66; WP, May 20/94)

- The Justice Department joined a whistle-blower, David Vosoughkia, in a lawsuit accusing the Rockwell International Corporation of overcharging NASA by millions of dollars for contracts to build parts for the Space Shuttle. (Reuters, Apr 28/94; UP, Apr 28/94; *NY Times*, Apr 29/94; *WSJ*, Apr 29/94)

- The ashes of "Star Trek" creator Gene Roddenberry were flown on a Space Shuttle after his death in October 1991, at the request of his widow, according to a NASA spokesperson. (AP, Apr 28/94; UP, Apr 28/94; Reuters, Apr 28/94)

April 30: The Boeing Company denied any intentional wrongdoing but paid the U.S. Government \$75 million to settle accusations that it systematically overcharged and mischarged the Government on military contracts. U.S. Attorney Kate Pflaumer said the most egregious mischarging was in Boeing's divisions that explored artificial intelligence applications to robotics, military command and control, high-speed jets, and Space Stations. Boeing admitted having

improperly charged the Government several million dollars in costs incurred in selling aircraft overseas and having charged the Government millions of dollars for hazardous-waste disposal. (*NY Times*, Apr 30/94; *WSJ*, Apr 30/94)

March/April: NASA achieved its congressionally mandated small disadvantaged business (SDB) contracting goal one year early. It was to reach an 8 percent SDB goal by fiscal year 1994. Instead, in 1993, NASA awarded 8.5 percent of its contracting budget to SDBs, women-owned firms, and Historically Black Colleges and Universities. (*Minority Business Entrepreneur*, Mar/Apr 94)

April: NASA opened its first Small Business Outreach Program at the New Hampshire Technical College in Nashua. The Center for Technology Commercialization, one of NASA's six Regional Technology Transfer Centers, signed an agreement to oversee the program, which was a pilot project to assist New England businesses competing for NASA contracts. The Program was to focus on small and disadvantaged businesses. (*Black Media News*, Apr 94)

- NASA's Goddard Space Flight Center, Greenbelt, Maryland, and the U.S. Agency for International Development (AID) since 1987 had cooperated to provide data to AID's Famine Early Warning System (FEWS). NASA satellite data, used to study the expansion and contraction of deserts and semi-arid lands of Africa, were the principal data providing early warning of potential famine and desert locust swarms. Using daily data from the National Oceanic and Atmospheric Administration meteorological satellites, scientists measured the density of green vegetation every 10 days. When drought conditions were detected, an AID-FEWS team could begin to coordinate relief efforts, if needed. The same data also were used for locust control purposes. (*Black Media News*, Apr 94)

- A feature article described repairs executed by NASA astronauts, and particularly board-certified surgeon Story Musgrave, to the Hubble Space Telescope. The Hubble now could spot the light of a firefly 8,500 miles away. James Crocker, an engineer with the Space Telescope Science Institute in Baltimore, proposed Hubble's "eyeglasses," called COSTAR (Corrective Optics Space Telescope Axial Replacement); other equipment also was added. Details concerning Mars Observer spacecraft also were given. (*Popular Science*, Apr 94)

May

May 1: Of the 250 people who flew in orbit on U.S. spaceships since 1961, only six astronauts were black. This surprised J. Alfhred Phelps, a retired Air Force master sergeant and author of a just published book: *They Had a Dream: The Story of African American Astronauts*. The author described two black Americans who almost became astronauts in the 1960s, as well as the six who made it: Guion Bluford, Ronald McNair, Frederick Gregory, Mae Jemison, Charles Bolden, and Bernard Harris. (*Fla Today*, May 1/94)

- Worldwide pollution was revealed among other things by the Measurement of Air Pollution by Satellite (MAPS) instrument, flown on Space Shuttle Endeavour, which showed atmospheric carbon monoxide levels. Not only can this pollution contribute to global warming but it also can make it more difficult for the atmosphere to cleanse itself. (*Fla Today*, May 1/94)
- The publication of *Moon Shot* by Alan Shepard and Deke Slayton was set for release one month before the 25th anniversary of the Apollo 11 lunar landing. The book gives a history of space flight and includes many little-known anecdotes. (*Fla Today*, May 1/94)

May 2: NASA announced that the six astronauts who recently returned from Endeavour's mission would be available for interviews as time permits during their debriefing schedule. (NASA Release 94-67)

- Astronaut Tom Jones was featured in a telephone interview in which he described his thrill with the experience of weightlessness, the spectacular views from the air, especially of the oceans and the distinctiveness of the various continents, the beauty of the United States, and the difficulty of readjusting physically to Earth's atmosphere. (*B Sun*, May 2/94)
- NASA's last SCOUT (Solid Controlled Orbital Utility Test) launch vehicle was scheduled to blast off May 6 from Vandenberg Air Force Base, Lompoc, California, the final of 118 space missions that began July 1, 1960. Called the Miniature Seeker Technology Integration spacecraft, the satellite is one in a series of military spacecraft being launched to develop sensors for ballistic missile devices. Since the mid-1960s, NASA gradually has gotten out of the unmanned rocket business, which was transferred to commercial manufacturers. (*Fla Today*, May 2/94; NASA Release 94-72; *Fla Today*, May 9/94; Reuters, May 9/94)
- NASA announced the selection of a research consortium headed by IBM to carry out research and test computer systems for a new national aerospace research program using parallel computer technology. NASA's Ames Research

Center, Moffett Field, California, was to be the main computational site for the new program (NASA Release C94-k)

- NASA astrophysicist Fred Espenak stated that an annular eclipse would be visible to observers within a 145-mile wide path from El Paso, Texas, through Toledo, Ohio, and much of New England on May 10. The Moon will appear completely silhouetted against the Sun, which will form a dazzling unbroken outer ring for up to six minutes. People outside the ground path will see only a partial eclipse. (Reuters, May 2/94; *W Post*, May 4/94; *B Sun*, May 8/94; *W Times*, May 8/94; *W Post*, May 9/94)

- The enthusiastic response of girls to attending NASA's "Take Our Daughters to Work Day" on April 28 was highlighted. The girls, ages 9 to 15, heard speakers and then trailed their parents or other staff members. (*Federal Times*, May 2/94)

- Vice President Al Gore made a brief fundraising stop in Huntsville, Alabama. He said that the International Space Station had tremendous foreign policy advantages for the United States as part of a new effort to create a partnership with Russia. Gore also cited Russia's decision to channel its resources into the Station rather than ballistic missile programs, for example. (*Huntsville News*, May 3/94; *Htsvl Tms*, May 3/94)

May 3: Robot spacecraft Clementine successfully completed a two-month mission to map the Moon's surface in unprecedented detail. Radar data indicate what scientists term an "astonishing" depth of 7.5 miles in one of the Moon's ancient basins. Other data may reveal ice in a permanently shadowed spot at the lunar south pole. At 6:20 p.m. EDT, controllers were to command the spacecraft to fire its rockets for four minutes to remove it from lunar orbit, loop around Earth, and head for the small asteroid 1620 Geographos for a late August rendezvous. NASA provided funding to refocus the mission effort, substituting the Moon and asteroids for man-made "Star Wars" objects. (*W Post*, May 3/94; *NY Times*, May 4/94)

- NASA Administrator Daniel S. Goldin announced Agency plans to proceed with the use of the nearly completed facilities at Yellow Creek in Iuka, Mississippi, originally designed for use with the proposed Advanced Solid Rocket Motor (ASRM), for use with the manufacture of nozzles for the current Space Shuttle Redesigned Solid Rocket Motor (RSRM) program. NASA and the Thiokol Corporation worked out plan implementation, which was scheduled to take approximately two and a half years. Thiokol plans to move all of its nozzle operations to the Yellow Creek facility. In view of the Federal government's investment of taxpayer money in the construction of the Yellow Creek facility, NASA was committed to obtaining maximum return while seeking to mitigate the economic impact on the region resulting from the ASRM termination. (NASA Release 94-68)

- NASA's Marshall Space Flight Center, Huntsville, Alabama, awarded the Computer Sciences Corporation, Arlington, Virginia, an eight-year contract to provide Program Information Systems Mission Services (PrISMS). (NASA Release C94-l; *W Post*, May 4/94)

- The Air Force launched a Titan 4 rocket with a Defense Department secret payload from Cape Canaveral, Florida. (Reuters, May 3/94; *H Chron*, May 4/94; *H Post*, May 4/94)

May 4: NASA Program Manager for Human Systems Technology in the Office of Aeronautics, Washington, DC, announced that NASA was designing an electronic chart to make flying safer for aerial firefighters who often fly in potentially dangerous conditions above forest fires. The Electronic Chart Display being developed at NASA's Ames Research Center, Moffett Field, California, shows pilots an area's terrain and obstacles on a computer screen. (NASA Release 94-69)

- NASA recognized 24 students from public and private schools across the United States as winners in its 14th annual Space Science Student Involvement Program. Co-sponsored by NASA and the National Science Teachers Association, the program involved more than 4,000 students in elementary, junior high, and high school who competed in five categories: mathematics, science, technology, art, and creative writing. In addition to being recognized in Washington at the National Space Symposium, May 7-11, students were to have the chance of interning at a NASA Field Center for a week in summer and to receive a Space Camp scholarship. (NASA Release 94-70)

- NASA's Langley Research Center, Hampton, Virginia, announced the selection of EG&G Langley, Inc., Hampton, Virginia, for a contract to provide maintenance, construction, and engineering support for the Center. (NASA Release C94-m)

- Interfax news agency reported that following unsuccessful talks with Kazakhstan about extending the use of its traditional base at Baikonur, Russia planned to launch a post-Soviet space ship in 1996 from its own territory, using the rocket complex at the city Svobodny-18 in the northeastern Amur region. (Reuters, May 5/94)

- Jack Levine, Director of Flight Programs in NASA's Office of Advanced Concepts and Technology, said that after considering the findings of a technical review panel, NASA decided to cut off funding for the Commercial Experiments Transporter (Comet) in FY 94. Comet was conceived as an alternative to the Space Shuttle; it would use an expendable rocket to orbit commercial experiments, some of which would be brought back to Earth aboard a recovery capsule after 30 days. Costs exceeded estimates and for that reason

and the panel's findings, NASA decided to discontinue the program. (*Defense Daily*, May 5/94)

- NASA Administrator Daniel S. Goldin gave an impassioned defense of NASA to a group of aerospace executives attending an American Institute of Aeronautics and Astronautics conference in suburban Washington. He described the budget fight as part of Congress's continuing effort to turn the space program into a "debating society" and said it was time for the talk to stop. He deplored the fact that NASA was not given enough money to create a space program about which American youth could dream. Jim Sensenbrenner, Republican from Wisconsin, who sat next to Goldin, in contrast spoke of "a fatally flawed space station program" on which space dollars should not be risked. (*O Sen Star*, May 5/94; *Space News*, May 9/94)

May 5: George Brown, Democrat from California and chairman of the House Committee on Science, Space, and Technology, called a closed-door meeting on May 5 to discuss the \$30 billion International Space Station. He called the meeting after administration officials assured him that Space Station costs would not shortchange other NASA programs. Observers said Brown wished to assure that NASA received sufficient funds to conduct its activities. Committee members decided they could take no action until they heard of the decisions of the Appropriations Committee. (*Fla Today*, May 5/94; *AP*, May 5/94; *O Sen Star*, May 6/94; *H Chron*, May 6/94; *H Post*, May 6/94; *Fla Today*, May 6/94; *LA Times*, May 11/94; *Huntsville News*, May 11/94)

- A Russian Military Space Forces official told Reuters that Russia planned a series of unmanned space launches to its orbiting Space Station Mir in May before a manned launch in June with a cosmonaut from Kazakhstan. The unmanned launches were to consist of a cargo spacecraft, a communications satellite in a joint program with the U.S. company Rimsat, and two military satellites. (Reuters, May 5/94)

- NASA Administrator Daniel S. Goldin announced that members of the NASA Hubble Space Telescope Recovery Team would receive the 1993 Robert J. Collier Trophy from the National Aeronautic Association on May 6 for their outstanding work. (NASA Release 94-71; *H Post*, May 6/94)

May 6: Two former employees of Rockwell International Corporation who worked in company machine shops in Houston and Canoga Park, California, called the *New York Times* to charge that they observed supervisors falsifying accounts by charging items to NASA when workers were actually idle or working on personal projects. Rockwell officials indicated they found the charges hard to believe. (*NY Times*, May 7/94)

May 8: Dale Hemke, a spokesperson for the Goddard Space Flight Center, Greenbelt, Maryland, said that not only does NASA want the public to know about some of the important work being done at the Center but also it wants children to participate in the technology so that their interest in mathematics will continue. Children can spin in the gyro chair, command a mock Gemini spacecraft, and retrieve a satellite. But the most popular event occurs on the first and third Sundays of the month when a launch pad is set up and enthusiasts may watch or participate in safe model rocket launches. (*B Sun*, May 8/94)

- NASA plans to show "Destiny in Space" on the 25th anniversary of the historic Apollo 11 launch, July 16, according to Eddie Harrison, chief of the media services branch at Kennedy Space Center. The IMAZ film to be shown at Spaceport USA includes photos of the Hubble Telescope repair mission. (*Fla Today*, May 8/94)

May 9: Representatives of NASA and the Departments of Commerce, Defense, Energy, and Transportation conducted a National Facilities Study. The study established the need for two new wind tunnels and made 70 recommendations affecting aeronautics and space facilities nationwide. (NASA Release 94-73; *Fla Today*, May 22/94)

- NASA announced the signing of a contract modification with Rockwell International Space Systems Division, Downey, California. The contract provided for the production of the Multifunction Electronic Display Subsystem (MEDS) to be installed in each of the four Space Shuttle orbiters. MEDS is to replace some of the current electromechanical flight instruments and meters in the shuttle cockpit. (NASA Release C94-n)

- The Defense Department said that robot spacecraft Clementine suffered a malfunction on May 7 that would prevent it from flying by and photographing the asteroid Geographos. However, Clementine was to continue to perform a military mission that would test 23 "advanced technologies." On May 19, the managers of Clementine were to fire its main thruster to ease the craft into a circular path between the Moon and Earth, where they can continue to test its prototype military components in the upper reaches of the Van Allen radiation belts around the planet. Since its January 25 launch, Clementine has provided 1.5 million images of the Moon at a bargain price. (*W Post*, May 10/94; *NY Times*, May 10/94; *USA Today*, May 10/94; *W Post*, May 11/94; *W Times*, May 13/94; *W Post*, May 19/94)

- The Boeing Company announced that it planned to cut about 900 jobs at its plant in Huntsville, Alabama, because it lost an eight-year, \$1.05 billion contract with NASA. However, Boeing anticipated that Computer Sciences Corporation, which won the NASA contract, would hire most of the affected workers. (*NY Times*, May 10/94)

- On May 9, NASA stopped accepting proposals for its pilot project High Performance Computing and Communications Program. More than 400 communities, corporations, and school districts submitted proposals for using NASA's vast databases via the Internet. Winners of the cooperative agreements were to be announced in July. Scottsdale, Arizona, one of the communities that submitted a proposal, hoped to use NASA data to help urban development and balance such development against environmental considerations. (*LA Times*, May 10/94)

- Lockheed Space Operations Company in Titusville announced that 183 personnel would lose their jobs as a result of NASA budget cuts. Lockheed was the main contractor in a \$607 million-a-year shuttle processing agreement with NASA. (*Fla Today*, May 10/94)

- Robert Raspen, NASA deputy assistant inspector general for auditing, said NASA had rejected its auditor's advice that it discontinue its use of Spacehab Corporation. NASA felt it needed Spacehab to conduct its commercial experiments. (*Fla Today*, May 10/94)

May 10: NASA's Lewis Research Center, Cleveland, Ohio, announced the award to Gilcrest Electric and Supply Company, Elyria, Ohio, of a contract to provide technical and fabrication services for the Center's in-house research and development program. The Lewis Center also announced the selection of R&R International, Akron, Ohio, for a contract for facilities operations and technical support services. (NASA Release C94-o; NASA Release C94-p)

- John Gibbons, White House science adviser, said that as a result of tight budgets the Government would combine the operations of civilian and military weather satellite systems: two belonging to the Defense Department and two belonging to the National Oceanic and Atmospheric Administration (NOAA). The combining should save as much as \$300 million by the end of 1999. Under an interagency agreement, the Defense Department was to procure future weather satellites, the Commerce Department's Atmospheric Agency was to operate the system, and NASA was to conduct research on advanced technology to be incorporated into the new spacecraft. The program became a joint Defense Department-NASA project in 1993. NASA was to build and launch a Landsat 7 spacecraft to replace the aging Landsat 4 and 5 spacecraft. NASA also was to design a new generation of spacecraft to compete with foreign satellites that provide similar data. On May 11 John Morgan, Director of the European weather satellite operations (Eumetsat) said he would discuss with nations that participate in European satellite and space programs NOAA's invitation to join the combined weather satellite system. These agencies already cooperate with NOAA on developing a Joint Polar System. (AP, May 10/94; *NY Times*, May 11/94; *W Post*, May 11/94; *O Sen Star*, May 11/94; *Fla Today*, May 12/94)

- The General Accounting Office, in a report to Congress, said that NASA's Jet Propulsion Laboratory in Pasadena, California, managed by the California Institute of Technology, was poorly controlled and lost about \$1 million in property annually. (Reuters, May 10/94; *O Sen Star*, May 11/94; *Fla Today*, May 11/94; AP, May 11/94)

May 11: NASA announced that as a result of tests it conducted jointly with McDonnell Douglas and the U.S. Army, converting a small area of a helicopter main rotor blade into a controllable flap reduced by 40 percent the strength of the sound from "blade slap." (NASA Release 94-74; *W Post*, May 12/94; *Daily Press*, Jun 13/94)

- The new chairman of the House Appropriations Committee, David Obey, Democrat from Wisconsin, divided a \$540 billion Federal spending budget in such a way that NASA had a good chance of getting 98 percent of the funds it requested for FY 1995. Efforts to kill the International Space Station project on the House floor remained likely. (*O Sen Star*, May 12/94; *Fla Today*, May 12/94; *H Chron*, May 13/94; *H Post*, May 13/94; *W Post*, May 13/94; *SP News*, May 16/94)

- The Technical and Business Exhibition and Symposium (TABES) held a two-day session in Huntsville, Alabama. The five panelists at the opening session were Ben Bova, ex-president of the National Space Society; John Pike, space policy director for the Federation of American Scientists; Harry Craft Jr., Director of the Technology Transfer Office at NASA/Marshall Space Flight Center; Peter Diamandis, co-founder of the International Space University; and Richard Jacobson, former president of Spacehab, Inc. The panelists debated how practical NASA could be and still have a visionary program for science exploration. Panelists concluded that NASA needed to do a better job of marketing its product. (*Huntsville News*, May 11/94; *Htsvl Tms*, May 11/94)

- Japanese Prime Minister Tutomu Hata's Space Activities Commission announced that Japan's first woman astronaut, Chiaki Mukai, a medical researcher, was to take part in NASA's Columbia flight set for launch July 8. The flight was to conduct some 80 experiments under the second International Microgravity Laboratory Project, of which Japan is a member. (UP, May 11/94)

May 12: NASA Administrator Daniel S. Goldin announced that NASA would stop work on the Polar spacecraft and would continue with pre-launch activities on the Wind spacecraft. Work on Polar was to resume only after the Wind spacecraft had operated successfully on-orbit and after a reevaluation of resources needed to complete the program within budgetary limits. (NASA Release 94-75; *SP News*, May 16-22/94)

- NASA staff at the Kennedy Space Center began moving into a new \$72 million building where all U.S., European, Japanese, and Canadian station hardware were to be prepared for launch. The modern computers and equipment in the new control rooms were commended particularly in the media. (*Fla Today*, May 13/94; *B Sun*, Jun 2/94; *W Post*, Jun 2/94; *O Sen Star*, Jun 2/94; *CSM*, Jun 3/94)

- NASA Administrator Daniel S. Goldin gave the commencement address at Tullahoma to 22 University of Tennessee Space Institute graduates. He said Congress had been supportive but the Nation needed to decide where it was going. America used to have a vision and be willing to take risks, but it had lost confidence in itself and was willing to settle for mediocrity. He pointed out that the cost of the entire space program “was only a quarter of a percent of the gross national product” so canceling one program would not solve the Nation’s problems. (*Htsvl Tms*, May 13/94; *Independent*, May 14/94)

- While visiting the University of Tennessee, NASA Administrator Daniel S. Goldin said NASA had to share responsibility for the failure of the canceled Commercial Experimental Transporter (Comet) spacecraft program. The University of Tennessee Space Institute (UTSI) managed the project, which involved other universities and private contractors. The goal was to provide a lower cost alternative for ferrying private industrial experiments into orbit. Goldin said UTSI was not to blame for the cost overruns that nearly doubled the project’s price; in retrospect, NASA should have been more active and offered help to UTSI. (*AP*, May 13/94)

May 13: NASA’s Marshall Space Flight Center, Huntsville, Alabama, announced the selection of Boeing Defense and Space Group, Missiles and Space Division, Seattle, Washington, for a contract to provide the Shuttle Upper Stage system with related integration and launch support services for the space-based Advanced X-ray Astrophysics Facility (AXAF). (NASA Release C94-q)

May 15: Rene Pellat, head of the French space organization CNES, said that both the Mars 94 and Mars 96 proposed Russian missions with large international participation were to be postponed by at least two years because of Russia’s economic difficulties. (*W Times*, May 15/94)

- Hal Francis, the former FBI agent who led the 20-month investigation of NASA conducted by the FBI, the NASA Office of the Inspector General, and the Defense Criminal Investigative Agency, said at least 25—and perhaps as many as 50—cases of suspected corruption among employees and contractors at NASA were strong enough to merit criminal charges. To date, however, charges had been filed against only eight individuals and one company as a result of Operation Lightning Strike. Francis believed that the U.S. attorney’s

office pursued only the "easy" cases, but Assistant U.S. Attorney Abe Martinez denied this and said other charges were to be filed. Francis and his colleagues in the sting operation demonstrated they could influence illegal major government contracts worth nearly \$2.4 billion at Johnson Space Center alone. (*H Chron*, May 15/94)

May 16: The anticipated fight over the budget and, specifically, the likelihood that NASA's appropriation would be cut and that further efforts would be made to eliminate funding for the International Space Station was featured prominently in the media. (*SP News*, May 16-22/94; *Fla Today*, May 16/94; *Defense Daily*, May 16/94; *H Chron*, May 17/94)

- In the absence of a National Space Council chaired by the Vice President, Vice President Al Gore's office became the focal point for space policy. Gore and the White House seemed confident that the administration had sufficient support to pass the Space Station. (*SP News*, May 16-22/94)

- More than 1,200 NASA workers of the nearly 2,000 NASA staff who applied received an early retirement bonus. The early retirement program reduced NASA personnel from 24,000 at the beginning of 1994 to 22,500 as of the beginning of 1995. (*SP News*, May 16-22/94)

- Sayed Z. Shariq, Director of the Office of Commercial Technology at NASA's Ames Research Center, said NASA had reshaped its technology transfer program so as to make it an integral part of NASA's business relationships with the private sector. In this regard, Shariq said that government should adapt to industry's practices and both NASA and industry should work together during the research and development, product planning, prototyping, and fabrication stages. In addition, Agency staff performance evaluations, incentives, and awards should be structured to foster commitment to the commercial program. One of the first signs of NASA's commercialization mission was the Aerospace Industry Technology Program, funded at \$20 million for FY 1994. (*AvWk*, May 16/94)

- U.S. astronauts Norman Thagard and Bonnie Dunbar, who are training in Russia, returned to Johnson Space Center with the four Russian cosmonauts with whom they will fly in March 1995. The six were in Houston for three weeks to learn about U.S. science experiments planned for their flights. (*H Post*, May 17/94)

- Astronaut Bill Shepherd, deputy manager of the Space Station program office in Houston, said that NASA had contingency plans for building the International Space Station without Russian assistance, if necessary. However, NASA fully expected Russian participation. (*Fla Today*, May 17/94; *H Chron*, May 17/94)

May 17: NASA was commended for raising the problem of debris mitigation in space to a high policy goal and for being in the process of drawing up a detailed rule book for its spacecraft designers, launchers, and operators to avoid creating debris. The commercial sector was the unknown in this regard, particularly with reference to communications satellites. The matter was a vital one because over the years several satellites were lost for unknown causes and may have been victims of "space junk." (*NY Times*, May 17/94)

- Terri Bracher, Patrick Air Force Base spokesperson, said the first nighttime practice rescue operation for Space Shuttle crew who might be downed at sea is to be conducted on May 18 near Kennedy Space Center. More than 200 members of the Air Force, Air National Guard, Marines, Air Force Reserve, Coast Guard, and NASA were to take part. Rescuers were to use night vision goggles and NAVSTAR Global Positioning System receivers to find the floating crew members. (*O Sen Star*, May 17/94)

- NASA Administrator Daniel S. Goldin told the House Appropriations Subcommittee meeting to consider NASA's budget, that NASA needed \$2.1 billion for the International Space Station and could not build the station for less. (*AP*, May 17/94)

- William Baragar, Boeing Company's corporate director of congressional affairs, said that Boeing planned to help NASA develop a High Speed Arm Transport (HSAT) that could cut flying time from Los Angeles to Tokyo from 12 hours to four. Baragar said NASA had asked Congress for \$220 million for research on the plane, which could fly at about 2.4 times the speed of sound or slightly faster than the Concorde and carry about 300 people. NASA Administrator Daniel S. Goldin also discussed the project with a British newspaper. (*Antelope Valley Press*, May 17/94; *Financial Times of London*, May 30/94; *LA Times*, Jun 1/94)

May 19: NASA announced that the Hubble Space Telescope's Wide Field Planetary Camera 2 returned valuable new images of the supernova 1994 I in the inner regions of the "Whirlpool Galaxy," M51, located 20 million light-years away in the constellation Canes Venatici. A supernova is a violent stellar explosion that destroys a star while ejecting the products of nuclear burning into the gas between stars. (NASA Release 94-76)

- NASA also announced that the Hubble Space Telescope had obtained the best images yet of a mysterious mirror-imaged pair of rings of glowing gas that encircle the site of the stellar explosion supernova 1987A. The explanation of the pair of rings was uncertain. (NASA Release 94-77; *Reuters*, May 19/94; *AP*, May 19/94; *NY Times*, May 20/94; *B Sun*, May 20/94; *W Post*, May 20/94; *USA Today*, May 20/94; *CSM*, May 26/94)

- NASA announced the award of contracts to 16 research teams for advanced aeronautics projects and studies in its largest solicitation of breakthrough ideas from industry, universities, and other government agencies. Sponsored by NASA's Office of Aeronautics, under the Advanced Concepts for Aeronautics program, the contracts were to develop aeronautical concepts that were technologically risky, but had a high potential payoff for U.S. industry. (NASA Release C94-r)

- NASA's Goddard Space Flight Center, Greenbelt, Maryland, and its affiliated sites—Wallops Flight Facility in Wallops Island, Virginia, and NASA Headquarters in Washington, DC—announced the selection of Cortez III Services Corporation of Albuquerque, New Mexico, to provide comprehensive logistics services to these sites. The services included transportation, flight project planning and coordination support, supply management, warehousing, property management and disposal, mail services, forms and records management, and interior design. (NASA Release C94-s)

- George E. Brown, Jr., Democrat from California and chairman of the House Science, Space, and Technology Committee, said that if Congress allocated NASA less than \$14.15 billion in the 1995 budget, he would probably oppose continuing the Space Station program in its present form. He said that he would submit a reduced NASA budget to Congress that kept Space Station funding intact but eliminated one Shuttle flight, the planned Mars Surveyor project, and other items. Senator Barbara Mikulski, Democrat from Maryland and chair of the subcommittee that oversees NASA's annual appropriation, said the subcommittee needed to receive a higher 602 (B) budget allocation than its House counterpart to sustain NASA's programs. She added that if the Space Station lost in the House, she thought it would be difficult to maintain it. (*W Post*, May 20/94; *NY Times*, May 20/94; *Fla Today*, May 20/94; *O Sen Star*, May 20/94; *Defense Daily*, May 20/94; *W Post*, May 20/94; *AvWk*, May 23/94)

May 20: NASA announced that it had assumed the satellite-development contract for Landsat 7 from the Department of Defense. NASA's Goddard Space Flight Center, Greenbelt, Maryland, was to manage the contract with Martin Marietta Astro Space, Valley Forge, Pennsylvania. Landsat 7 was to provide essential land remote-sensing data critical to understanding environmental change. (NASA Release 94-78)

- NASA announced that the first set of solar array modules for the International Space Station program were to be shipped from the United States to Russia at the end of May. The modules were prototypes of flight units to be delivered in September to be incorporated into advanced solar arrays for use on Russia's Space Station Mir. (NASA Release 94-79; *UP*, May 23/94)

- From Baikonur Cosmodrome in Kazakhstan, Russia launched one of its Gorizont communications satellites for the U.S. firm Rimsat, putting it into orbit at about 22,300 miles above Earth. This was the second launch of a Russian spacecraft for Rimsat. The Gorizont went into orbit over Malaysia, with AllAsia Sat of Manila as its first customer. (UP, May 20/1994)

- The American Society of Mechanical Engineers task force studying budgeting for NASA issued its report to the subcommittee of the Senate Appropriations Committee. It said that, "the proposed funding levels are inadequate to support both a balanced aerospace science-technology program and an active program of human spaceflight, including the redesigned space station." The report maintained that the work intended for the proposed Space Station could be done by robotic spacecraft or other efforts. (*H Chron*, May 21/94)

May 22: Alex Roland, a professor of military history and technology at Duke University, wrote a feature article in the "Outlook" section in which he maintained that promoters of the costly Space Station and the Space Shuttle were forcing abandonment of science experiments that would be more valuable. (*W Post*, May 22/94)

May 23: Former NASA astronaut and Space Shuttle commander Ronald J. Grabe assumed his new post as vice president of business development for the launch systems group of Orbital Sciences Corporation (OSC) in Sterling, Virginia. He explained that OSC's specialty was providing access to space for small satellites at reasonable cost. One of his priorities was to find new markets for OSC's Taurus and Pegasus rockets. OSC also was about to enter the communications field through its ORBCOMM satellite system. (*W Post*, May 23/94)

- NASA Administrator Daniel S. Goldin announced the signing of an agreement between NASA and the Multiple Sclerosis Association of America (MSAA) to collaborate to advance the application of cool suit technology for multiple sclerosis (MS) patients. More than 300,000 Americans suffer from MS, for which there is no known cure. About 1,000 MS patients use the current cool suit, used as a space suit undergarment for cooling astronauts on the surface of the Moon or during space walks, for systematic relief. Members of NASA's Johnson Space Center, Houston, and Ames Research Center, Moffett Field, California, were to work with MSAA staff to improve the performance of cool suits. (NASA Release 94-80)

May 24: NASA announced that together with the American Geophysical Union it was honoring pioneer space scientist James A. Van Allen on his 80th birthday. Dr. Van Allen, Professor Emeritus at the University of Iowa, over a 50-year period, studied planetary magnetospheres and cosmic rays. He discov-

ered the belt of radiation around the Earth that bears his name. (NASA Release 94-81; *Fla Today*, May 25/94)

- Russian cosmonaut Sergei Krikalev planted a 12-foot live oak tree beside NASA's headquarters building at Kennedy Space Center. This was to commemorate his flight on Space Shuttle Discovery in January. In Russia, cosmonauts plant trees to commemorate each of their space flights. (*Fla Today*, May 25/94)

May 25: NASA announced that the Hubble Space Telescope had discovered the best evidence yet of a black hole in the constellation Virgo. The proof consisted of a whirlpool of hot gas at the core of galaxy M87, which lies more than 52 million light-years from Earth. The stars in the whirlpool appeared to be streaming toward the galaxy's center and then into orbits bound to an apparent black hole hidden at M87's core. Data from the Hubble spectrometer, used to measure the velocity of stars orbiting within the nucleus of the M87 galaxy, also appeared to confirm the black hole. Sally Heap, a NASA astronomer, at a national meeting of the American Astronomical Society, commented on the Hubble findings in terms of her own research. (NASA Release 94-82; *Fla Today*, May 25/94; *B Sun*, May 26/94; *USA Today*, May 26/94; *W Post*, May 26/94; *NY Times*, May 26/94; *W Times*, May 26/94; *Fla Today*, May 26/94; *WSJ*, May 26/94; *O Sen Star*, May 26/94; AP, May 26/94; CSM, May 26/94; *Oregonian*, May 27/94; *Fla Today*, May 29/94; AP, May 30/94; *H Chron*, May 31/94; *C Trib*, May 31/94; *W Post*, Jun 2/94; *Plain Dealer*, Jun 2/94; *Newsweek*, Jun 6/94)

- NASA released new pictures of asteroid 243 Ida and its recently discovered Moon taken by the Galileo spacecraft. Although similar in color and brightness, Ida and its moon appear to be composed of different types of material. (NASA Release 94-83)
- The Space Coast Science Center in Melbourne, Florida, which was used to educate children in the area about science, closed because of lack of funds. (*Fla Today*, May 27/94)

May 26: Major Oleg Kulakovsky of the Military Space Forces, the branch of the Russian army that runs Baikonur Cosmodrome, was quoted as saying that people were leaving adjacent Leninsk because "there's nothing to stay for." The population was said to have fallen from 100,000 to 45,000 since Kazakhstan gained independence from the Soviet Union in 1991. Kazakhstan has a severe energy crisis and a chronic water shortage, which contribute to the harsh life for the population. Since the first Soviet manned space flight by Yuri Gagarin in 1961, Baikonur has averaged one launch a month, according to General Oleg Goryushkin, space center deputy commander. However, the space industry appears to be undergoing a crisis of confidence, and in view of

Russia's economic crisis, the cost of maintaining Baikonur is being questioned. (UP, May 26/94)

- NASA announced that the Clementine mission, sponsored by the Department of Defense Ballistic Missile Defense Organization, had completed systematic mapping of the lunar surface to produce the first global digital map of the Moon. NASA's Clementine science team mapped the topography and composition of major regions of the Moon in detail and produced other important science results released at the meeting of the American Geophysical Union in Baltimore, Maryland. The digital data cover 38 million square kilometers of the Moon mapped in 11 colors in the visible and near infrared parts of the spectrum during the mission's 71 days in lunar orbit. (NASA Release 94-84; B Sun, May 27/94)

- After the Senate decided to adjourn on May 25 for the Memorial Day holiday, the Senate Appropriations subcommittee that controls NASA spending postponed its initial hearings on NASA to June 7. (*Fla Today*, May 27/94)

- In a speech to the American Geophysical Union, NASA Administrator Daniel S. Goldin challenged scientists to establish an ambitious new goal for space science that would unite competing research disciplines and resurrect public excitement. As a possible goal, Goldin suggested that NASA commit itself to finding habitable planets outside the solar system. (*SP News*, May 30-Jun 12/94)

- Bowman Cutter, deputy assistant to the President for economic policy, took a lead in developing a space policy for the administration, according to a statement he made on May 26. As a first step, he convened a meeting May 13 at the White House with a diverse and bipartisan group of industry representatives, NASA managers, military officers, and academicians to discuss the space program's future. Although there was some talk about the Space Station, the major emphasis was on longer-term policy. Rather than new programs, White House officials said the focus was to be on streamlining NASA's bureaucracy, focusing research and development to help private industry, and pushing small missions to demonstrate advanced technologies. (*SP News*, May 30-Jun 12/94)

May 27: Space Shuttle Atlantis, refitted over a 19-month period at a cost of \$96 million to enable it to dock with Mir, was expected to arrive at Kennedy Space Center from its overhaul at Rockwell Space Systems Division in Palmdale, California. The plan was for Atlantis to dock with Mir during a series of 10 shuttle flights between 1995 and 1997. Other modifications were designed to make Atlantis safer. Atlantis' return means limited space at Kennedy Space Center for processing the various Shuttles. (*Fla Today*, May 27/94; AP, May 29/94; *W Post*, May 30/94; *Fla Today*, Jun 1/94)

- NASA announced the selection of six Hispanic-serving universities to receive five-year, Institutional Research Award grants for multidisciplinary research in science and engineering. The universities were to receive \$400,000 the first year, \$600,000 the second year, \$800,000 the third year, and \$1 million in the fourth and fifth years, for a total of \$3.8 million over the five-year period. The universities selected were: California State University at Los Angeles; Florida International University, Miami; New Mexico Highlands University, Las Vegas; City College of New York; University of Puerto Rico, Rio Piedras; and University of Texas at San Antonio. (NASA Release 94-85)
- NASA announced that scientists at its Marshall Space Flight Center, Huntsville, Alabama, had discovered unusual gamma-ray flashes in the upper atmosphere high above thunderstorms. The heretofore unseen flashes were detected by the Burst and Transient Source Experiment, a Marshall instrument aboard NASA's orbiting Compton Gamma Ray Observatory. (NASA Release 94-86; *W Post*, May 30/94)
- NASA announced that Space Shuttle astronaut William E. Thornton would retire from NASA on May 31. (NASA Release 94-87)
- Jon Linderman, a National Research Council fellow at NASA's Ames Research Center, said that, based on experiments with rats, exercise combined with growth hormone may help prevent muscle atrophy in astronauts, seniors, and patients confined to bed following illness or injury. Russian cosmonauts discovered that extensive exercise alone was insufficient to prevent muscle atrophy. (UP, May 27/94; UP, Jun 3/94)
- As a result of an investigation by NASA's Inspector General, Omniplan Corporation, with offices near the Johnson Space Center, four related companies, and five employees, together with the Chief Executive Officer Ralph Montijo Jr. and his wife, Guillermina, were named in a Federal grand jury indictment. They were charged with conspiracy to present false claims to NASA, embezzling from an employee benefits plan, money laundering, and making false statements to NASA, the Internal Revenue Service, the Small Business Administration, and the Defense Contract Audit Agency. The company had been previously indicted for allegedly swindling \$4 million from NASA and its own employees. Omniplan subcontracted through Rockwell Space Operations Company to write flight plan documentation for the Space Shuttle. The government filed a lawsuit to try to recover \$3.75 million. (*H Post*, May 28/94)

May 29: The Book Review section carried an extensive review of Eric J. Chaisson's *The Hubble Wars: Astrophysics Meets Astropolitics in the Two-Billion-Dollar Struggle Over the Hubble Space Telescope*. Chaisson served as spokesper-

son and director of educational programs for the Space Telescope Science Institute, a NASA-supported group of astronomers responsible for planning and directing the telescope's observational program. According to the author, the space telescope's progress toward scientific discovery was hampered by squabbling among NASA, the military intelligence community, industry, the press, and scientists. Some of the problems might have been avoided if the Hubble scientists had had access to the technical experience of the military intelligence community. (*NY Times Book Review*, May 29/94)

May 30: Jean-Marie Luton, director general of the European Space Agency (ESA), announced at a news conference in Berlin that veteran German astronaut Ulf Merbold would join two Russian cosmonauts for the first joint European and Russian EUROMIR 94 space flight scheduled for October 3. During the 30-day flight, 30 experiments prepared by scientists from ESA states were to be performed on board Russian Space Station Mir. (Reuters, May 30/94)

- European Space Agency (ESA) scientific director Roger Bonnet told a news conference that scientists and officials from the world's main space agencies were to meet in Switzerland on May 31 to discuss an ESA proposal for a joint international Moon program. The program, to cover a period up to 40 years, would begin with modest lunar orbit satellite missions and conclude by setting up human outposts on the Moon. Participants in the four-day conference were to include NASA, and the Russian and Japanese space agencies. (Reuters, May 30/94)

- NASA scientist Michael Van Woert discussed plans for a satellite in NASA's Mission to Planet Earth, which was to be a follow-on to the U.S./French topex/Poseidon then in orbit. The successor, to be launched in 1998, would be smaller and cost \$200 million. However, NASA cannot find the \$120 million for its share, which was to include building the spacecraft bus and integrating the instruments. The French space agency, CNES, offered to build the bus if NASA would help with integration and launch it, which should save the United States some \$50 million. (*AvWk*, May 30/94)

- Ken Szalai, Director of NASA's Dryden Flight Research Center at Edwards Air Force Base, said that construction of the hypersonic National AeroSpace Plane (NASP), the X-30, and its first flight scheduled for 2000 were no longer goals. Funding for the plane runs out in 1994, but Szalai said research into supersonic flight would not end. John Bass, deputy program manager for the NASP consortium of government and industry, including five aerospace firms, the Department of Defense and NASA, considered the decision a great loss. The one area remaining a problem was that of propulsion, which engineers could not test because the scramjet engine required to power the X-30 needed an environment where wind speeds reach 25 times the speed of sound. (*Bakersfield Californian*, May 30/94)

- Senator Barbara Mikulski, Democrat from Maryland and chair of the subcommittee that oversees NASA's appropriation, wrote a major article on space policy for a space trade journal. In it she discussed the Space Station and NASA's various redesigns of it, and the lack of a clear mission and a clear purpose. She said the redesigned station cost too much and its early scientific capabilities were too limited. Specifically, she pointed out that in the summer of 1993, NASA and the White House Office of Science and Technology Policy promised the Senate Appropriations Committee with NASA oversight that there would be the same level of science capability on the new station as on Space Station Freedom. That meant twice the power and space available on the current Space Shuttle. However, by November 1993, the power for science had been cut to about half of that available on the current Shuttle. This meant that it was far more difficult to win congressional support for the Space Station, particularly as budgets became tighter. Mikulski questioned whether enough votes for the Station would be available if it meant "killing the increase for National Science Foundation grants, national service, and funding for environmental technology or climate change." Furthermore, to avoid defeat, the Station needed to be approved by the House by a reasonable margin. She maintained that "Space policy should no longer be driven by the domination of the space station," adding that the United States needed to establish a consensus on space policy. (*SP News*, May 30-Jun 12/94)

- Sandy Valenti, project team leader at NASA's Lewis Research Center, said the Center had compiled an inventory of space-related technology that has relevance to biotechnology and the work of medical researchers in northeastern Ohio. NASA's goal was to support existing organizations in the community, such as local hospitals and universities. Six specific research areas in which NASA could provide technological support were fluid mechanics, electronics, communication and instrumentation, materials development and structural design, surface modification, and energy storage systems. (*Crain's Cleveland Business*, May 30/94)

May-June: A feature article on the International Space Station quoted the project's chief scientist Robert W. Phillips at the American Association for the Advancement of Science meeting in San Francisco as saying that the Station "is a facility that supports lots of individual experiments—small science." The author assessed the chances of the Station being realized in the face of congressional budget-cutting pressures and commended the political savvy of NASA Administrator Daniel S. Goldin. (*Space*, May-June 94)

June

June 1: NASA announced the dedication of the Independent Verification and Validation facility, a new research facility in Fairmont, West Virginia, that was to support NASA's work in advanced research, stimulate commercialization efforts, and provide training in a variety of engineering and technology areas. In addition to housing staff working on software for the International Space Station, it was to house parts of the Earth Observing System Data and Operations System. Senator Robert C. Byrd attended the opening. (NASA Release 94-88; *Times-West Virginian*, Jun 2/94)

June 2: University of Maryland radio astronomers indicated they had spotted water clouds near the center of a galaxy called Markarian 1, which is about 200 million light years away in the constellation Pisces. The finding was reported at the Minneapolis meeting of the American Astronomical Society. At that meeting, Johns Hopkins University astronomers reported several days previously having "very strong" evidence of a black hole at the center of the Andromeda galaxy. (*B Sun*, Jun 2/94; *P Inq*, Jun 3/94; *W Post*, Jun 3/94; *USA Today*, Jun 3/94; *NY Times*, Jun 3/94)

- NASA Administrator Daniel S. Goldin visited the University of North Dakota's Center for Aerospace Sciences (CAS). Goldin visited at the invitation of Senator Byron Dorgan, a member of the Commerce Committee, which oversees NASA and its budget. Goldin was impressed with CAS's new technology and the educational services and programs it conducted for children and the public as well as college students. (*Grand Forks Herald*, Jun 3/94)

June 3: NASA and the Canadian Space Agency (CSA) announced their agreement to put their space cooperation on a long-term basis. The arrangement provided for expanded cooperation in space science, microgravity research, and the Mission to Planet Earth, as well as Canada's continued full partnership in the International Space Station program. (NASA Release 94-89)

- NASA announced names of members of the crew of Atlantis for its mission in mid-1995 to perform the first docking with the Russian Space Station Mir. Robert L. Gibson was to command the 10-day mission, which was to include a Spacelab module. (NASA Release 94-90; *H Chron*, Jun 4/94; *H Post*, Jun 4/94)

June 6: NASA's Office of Advanced Concepts and Technology announced its solicitation of proposals from all sources for industry-led research and development projects under the Aerospace Industry Technology Program (AITP). AITP aims to develop and apply advanced technology rapidly in the aerospace industry and in the non-aerospace commercial marketplace. (NASA Release 94-91)

- A feature article described ways in which Pittsburgh was becoming "Robot City, USA." One of the reasons was NASA's \$2.5 million grant in May 1994 to Carnegie Mellon University's Robotics Institute to establish an engineering consortium that would transfer robotics technology to U.S. industry. Other robotic firms also came to Pittsburgh recently. Other than industrial uses for robots, NASA wants to use robots to explore Mars and get instruments on the planet's surface. David Pahnos, director of the new NASA-CMU consortium, saw an opportunity for Pittsburgh to become a technical center that pushed technology forward. (CSM, Jun 8/94)

- Russian and U.S. Mars mission planners were meeting the week of June 6 at NASA's Jet Propulsion Laboratory, Pasadena, California, to define how the two countries could best cooperate in a proposed multinational space exploration program to be called "Mars Together." France, Germany, and Italy were also considering joining the new 1998 mission to Mars. The new mission resulted from Russia's delay in its originally proposed "Mars 94" and "Mars 96" flights. The idea would be to combine major technological elements on which individual nations were already working. (AvWk, Jun 6/94)

- NASA and the Defense Department were evaluating a lunar rover mission for a Clementine 1 follow-on flight that would continue the validation of advanced, lightweight technologies for antiballistic defense applications. Clementine 1 was a Ballistic Missile Defense Organization (BMDO) mission that tested new avionics and sensor technologies during its lunar mapping. The Clementine follow-on flight could apply BMDO's technology to bring a rover to the Moon's surface. (AvWk, Jun 6/94)

June 7: NASA announced the selection by the White House of Charles R. Chappell, Associate Director for Science at NASA's Marshall Space Flight Center, to serve a one-year assignment as Deputy Director of the Global Learning and Observations to Benefit the Environment (GLOBE) program. Chappell was to head NASA's participation in the GLOBE program and was to report directly to the NASA Administrator. Chappell was to be assigned to the White House and together with the GLOBE director, Thomas Pyke Jr., was to work on the design and implementation of the GLOBE program for the Vice President. (NASA Release 94-92)

- NASA announced the award of a contract to the Boeing Company, Commercial Airplane Group, Renton, Washington, for engineering design and trade studies in support of the National Wind Tunnel Complex (NWTC). The NWTC was a joint effort between government and industry to construct state-of-the-art transonic and low-speed wind tunnels to meet the turn-of-the-century needs of the aerospace industry. The Wind Tunnel Program Office at NASA's Lewis Research Center, Cleveland, Ohio, was to manage the contract. (NASA Release C94-u)

- Senator Barbara Mikulski, Democrat from Maryland and head of the Appropriations subcommittee that oversaw NASA funding, informed NASA Administrator Daniel S. Goldin that he must consider cutting one of two major programs: the Cassini mission to Saturn or the Advanced X-ray Astrophysics Facility that included the Hubble Space Telescope. Reportedly, Mikulski said that if NASA did not make the decision, Congress would. On June 8, Goldin met with James Sensenbrenner, Republican from Wisconsin and the highest ranking Republican on the House space subcommittee, to answer his concerns about Russia's stability in view of its major Space Station role. (*NY Times*, Jun 8/94; *B Sun*, Jun 8/94; *USA Today*, Jun 8/94; *C Trib*, Jun 8/94; *H Chron*, Jun 8/94; *H Post*, Jun 8/94; *H Chron*, Jun 9/94; *O Sen Star*, Jun 13/94; *USA Today*, Jun 13/94)

- Canadian Industry Minister John Manley said that Canada was cutting its contribution to the International Space Station program from \$1.2 billion to \$500 million. It could not afford the proposed level of funding and instead was focusing its energies on helping Canadian space industries. (*H Post*, Jun 7/94)

June 8: NASA Administrator Daniel S. Goldin announced contract awards for two new "Smallsat" satellites to observe the Earth with unprecedented sensor technology. The awards went to two teams led by CTA of Rockville, Maryland, and TRW, Inc., of Redondo Beach, California. The teams were to build, launch, and operate the satellites—each no bigger than a console television set—for less than \$60 million each. The satellites were to be developed, launched, and delivered on orbit in 24 months or less on a Pegasus launch vehicle. (NASA Release 94-94; AP, Jun 8/94; Reuters, Jun 8/94; *NY Times*, Jun 9/94; *W Post*, Jun 9/94; *USA Today*, Jun 9/94; *WSJ*, Jun 9/94; *H Chron*, Jun 9/94; *H Post*, Jun 9/94; *SP News*, Jun 13-19/94; *W Post*, Jun 14/94)

- NASA announced the selection of 38 college students for an intensive six-week Space Life Sciences Training Program at its Kennedy Space Center in Florida. The summer residence training program was for undergraduate students majoring in life sciences, bioengineering, and related science and engineering fields. (NASA Release 94-95)

- NASA Administrator Daniel S. Goldin released a statement in response to the markup of NASA's budget by the House Appropriations Subcommittee on VA-HUD-Independent Agencies. He said that "Given the enormous challenge that Chairman Stokes and the members of his committee had in adequately addressing the many needs of the agencies covered in this budget, NASA is pleased with today's markup." He added that NASA was pleased to comply with the further challenge Stokes presented in the markup. (NASA Release, Jun 9/94; AP, Jun 9/94; *W Times*, Jun 10/94; *O Sen Star*, Jun 10/94; *Plain Dealer*, Jun 10/94; *H Post*, Jun 10/94; *Fla Today*, Jun 10/94; AP, Jun 10/94; *SP News*, Jun 13-19/94)

June 9: The U.S. attorney confirmed that David R. Proctor, an engineer assigned to the Life Sciences Project Division, was the first NASA Johnson Space Center employee indicted as part of the FBI's Operation Lightning Strike. The Operation began in December 1991 as an undercover probe into aerospace contractors. Proctor was indicted on charges of conspiracy and bribery, among others. (UP, Jun 9/94)

June 12: Ulysses, a European spacecraft deployed by U.S. Shuttle Discovery in October 1990, took three and a half years to travel the 93 million miles from Earth to the Sun's south pole. Between June and the fall of 1995, when it was due to pass the Sun's north pole, it would exhaustively examine the Sun—the first time the Sun had been observed from pole to pole. Ulysses was to examine the Sun's magnetic field, which influenced the solar cycles as well as the climate on Earth. The spacecraft also was to search for the source of gamma and gravity rays and to examine solar flares. (*W Times*, Jun 12/94)

- A feature article on astronaut Eileen Collins, based at Ellington Field, indicated that she was scheduled to be the first woman to pilot a Space Shuttle when the flight occurred in February 1995. (*Texas*, Jun 12/94)
- Astronaut Janice Voss, training for a mission aboard Russian Space Station Mir, appeared in a two-hour electronic conference concerning the Mir flight, NASA, the Space Station, and her qualifications for being an astronaut. (*Fla Today*, Jun 12/94)

June 13: Vice President Al Gore's Global Learning and Observations to Benefit the Environment (GLOBE) program was described. GLOBE was a joint effort among the National Oceanic and Atmospheric Administration (NOAA), NASA, the EPA, and private contributors. Funding was proposed in the budget at \$13 million: \$7 million from NOAA, \$5 million from NASA, and \$1 million from EPA. The goal was to promote technical education while collecting environmental data. (*Federal Computer Week*, Jun 13/94)

- NASA planned to launch a Mentor-Protege Program later in 1994. The goal was a three-year pilot program to encourage prime contractors to take young minority- and woman-owned businesses under their wings and teach them corporate skills. (*Federal Computer Week*, Jun 13/94)
- The Hubble Space Telescope enabled a team led by Rice University astrophysicist Robert O'Dell to survey 110 young stars in a field of 3,000 in the Orion Nebula, which was 1,500 light-years from Earth. As a result, O'Dell reported at a NASA news conference, scientists found that the material required to create planets was common around stars; the same would be true of Earth's home galaxy, the Milky Way. (Reuters, Jun 13/94; *W Post*, Jun 14/94; *B Sun*, Jun 14/94; *NY Times*, Jun 14/94; *LA Times*, Jun 14/94; *USA Today*, Jun 14/94; *H Post*, Jun 14/94)

June 14: Groups of citizen lobbyists, particularly from Florida, Texas, and Ohio, came to Washington to lobby Congress on the importance of the Space Station to the continuation of a manned space program. (*Fla Today*, Jun 15/94; *O Sen Star*, Jun 15/94)

- Former General Electric Aerospace employee Vincent S. Maleche was sentenced to a two-month prison term and a fine for providing confidential NASA documents to an undercover agent. The charge of fraud occurred in connection with Operation Lightning Strike. On June 15, former Armstrong Laboratory employee at Brooks Air Force Base in San Antonio, William C Alexander, pleaded guilty to providing documents to an FBI undercover agent. (Reuters, Jun 14/94; UPI, Jun 15/94; *H Chron*, Jun 16/94)

June 15: NASA announced the selection of Honeywell, Inc., for a contract for developing flight deck technologies in support of NASA's High Speed Research program. NASA's Langley Research Center, Hampton, Virginia, was to manage the eight-year project. The advanced technologies to be developed included design for a potential future High Speed Civil Transport. (NASA Release C94-r)

- Space Shuttle Columbia was moved to the launch pad to begin preparations for a July launching at Kennedy Space Center. (Reuters, Jun 15/94; *H Chron*, Jun 18/94)

- After a closed door session of the House Space Committee, Chairman George Brown, Democrat from California, said he would support the Space Station. The growing support for the Space Station also was reflected in public opinion polls. However, James Sensenbrenner Jr., Republican from Wisconsin and senior Republican on the Committee, was angry at the response to his concern about Russian participation in the space program from White House science adviser John H. Gibbons. (*H Chron*, Jun 16/94; *H Post*, Jun 16/94; *Fla Today*, Jun 16/94; *H Chron*, Jun 17/94)

- Vice President Al Gore addressed a group of NASA employees in Washington and commended the work of NASA staff at the Kennedy Space Center (KSC). He indicated that in the past few years the KSC shuttle team had cut the cost of each shuttle flight by \$43 million and assembled shuttles and moved them to the launchpad 40 percent faster and with one-third as much labor. (*Fla Today*, Jun 16/94)

June 16: NASA Johnson Space Center Director Carolyn L. Huntoon announced a number of changes designed to assure the success of the Shuttle and International Space Station programs. Changes included the establishment of a new Projects Office, a new Business Management Directorate, and a new Information Systems Directorate; encouragement of rotational assign-

ments and "teaming"; and new leadership appointments. Larry Bourgeois became head of the Projects Office, Terrence Hesse became Director of the Business Management Directorate, and Jane Stearns became Director of the Information Systems Directorate. A number of other appointments also were announced. (NASA Release 94-036; *H Chron*, Jun 17/94; *H Post*, Jun 17/94)

- Martin Marietta Corporation announced it would eliminate 1,800 of its 2,100 jobs at its recently acquired space launch business in San Diego. The company planned to move the production of Atlas and Centaur launch systems to its Titan rocket plant in Denver. (*LA Times*, Jun 17/94)

June 17: NASA announced that Space Shuttle Columbia was to conduct the second flight of the International Microgravity Laboratory-2. The flight would entail worldwide research into the behavior of materials and life in the weightless environment of Earth-orbit. Experiments were to include studies of subtle forces that affect microgravity and the reaction of living organisms to microgravity. Scientists from NASA, the European Space Agency, the French Space Agency, the German Space Agency, the Canadian Space Agency, and the National Space Development Agency of Japan cooperated in planning the experiments. (NASA Release 94-96)

- NASA announced that astronaut Charles F. Bolden Jr. was leaving NASA after 14 years to return to the Marine Corps to serve as Deputy Commandant of Midshipmen at the Naval Academy. (NASA Release 94-97; *W Times*, Jun 19/94)

- Guy Bluford, the first African American astronaut in space, served as master of ceremonies of a celebration the week of June 13, honoring the 30th anniversary of the Civil Rights Act. The Tuskegee Airmen participated as NASA honored those known as the "Civil Rights Movement of the Armed Services of World War II." (*Metro Herald*, Jun 17/94; *Washington Informer*, Jun 23-29/94)

- In a patent case, Hughes Aircraft Company won \$114 million from the U.S. government (represented by the Defense Department and NASA) as opposed to the \$4.8 billion it sought. At issue were royalties due under a patent developed by former Hughes engineer Donald D. Williams in 1959 for a single rocket nozzle for satellites. (*NY Times*, Jun 18/94; *P Inq*, Jun 19/94; *W Times*, Jun 19/94; *WSJ*, Jun 20/94)

June 20: NASA announced the selection of specialists for the Spacelab mission. (NASA Release 94-98)

- The Russian embassy in Washington announced that during Prime Minister Victor Chernomyrdin's visit to the United States the week of June 20, an

agreement on joint space exploration was scheduled to be signed. (Reuters, Jun 20/94; *USA Today*, Jun 21/94; AP, Jun 21/94)

- During Russell Colley's 35 years of employment as an engineer and inventor at B.F. Goodrich Company in Akron, he earned 65 patents. Among these was the spacesuit and a deicing device for planes. In the recent past, NASA awarded Colley its Distinguished Public Service Medal, the highest honor for a civilian. (*Plain Dealer*, Jun 20/94)

June 21: Former CBS news anchor Walter Cronkite was quoted as saying that in view of the lack of a guarantee that money saved from the space program would be used for urgent needs such as health, housing, education, and crime, the United States could not afford not to continue going into outer space. (*LA Times*, Jun 21/94)

- NASA's Office of Advanced Concepts and Technology announced the selection of six research proposals for contracts under Phase I of the Small Business Technology Transfer Program. This phase allows contracts valued at up to \$100,000 with 12 months to complete. (NASA Release 94-99)

June 22: NASA announced the selection of 34 scientists to participate in the experiment definition phase of the Neurolab Space Shuttle mission. This was to be a 14- to 16-day mission jointly with the National Institutes of Health, devoted to brain and behavioral research and was scheduled for launch in early 1998. Various domestic and international partners also were participating, such as Canada, France, Germany, Italy, Japan, the Netherlands, and Nigeria. (NASA Release 94-100; Reuters, Jun 22/94)

- The House Appropriations Committee approved a NASA budget of \$14 billion, \$240 million less than the administration's request. The approved budget included full funding, \$2.1 billion, for the Space Station. However, opponents threatened a major fight once the budget came to the House floor. Following receipt of assurances "protecting the American taxpayers from any unforeseen failure in the U.S.-Russian space partnership" in a letter from President Clinton the evening of June 22, the ranking Republican on the House subcommittee on space, James Sensenbrenner from Wisconsin, said he would support the Space Station. (AP, Jun 22/94; Reuters, Jun 22/94; *W Times*, Jun 23/94; *W Post*, Jun 23/94; *H Post*, Jun 23/94; *H Chron*, Jun 23/94; *H Chron*, Jun 24/94; *USA Today*, Jun 28/94; *W Times*, Jun 28/94)

- NASA Associate Administrator Charles Kennel visited the University of North Dakota's (UND) Center for Aerospace Science (CAS). Kennel was in charge of NASA's Mission to Planet Earth, for which UND's Associate Dean George Seielstad said UND had a small contract. Kennel stated that CAS was

well equipped and positioned to make data about the Earth available to non-traditional users. (*Grand Forks Herald*, Jun 23/94)

- Commenting on NASA Administrator Daniel S. Goldin's urging of space scientists to search for a habitable planet among the stars, science columnist Robert C. Cowen viewed such a quest as feasible in view of the discoveries of the Hubble Space Telescope. He saw the next phase of the search as involving a look for signs of gravitational interaction of a star and planets. (*CSM*, Jun 22/94)

June 23: NASA announced that it and the Russian Space Agency (RSA) had signed an "Interim Agreement for the Conduct of Activities Leading to Russian Partnership in Permanently Manned Civil Space Station." The agreement governed Russian participation until an Intergovernmental Agreement and a NASA-RSA Memorandum of Understanding could be concluded. NASA and RSA also signed a separate \$400 million contract under which NASA was to buy hardware and services from RSA for approximately \$100 million annually through 1997 in support of a joint program involving the U.S. Space Shuttle and the Russian Mir Space Station. Key elements of the contract were spelled out. The agreement and contract were signed separately by NASA Administrator Daniel S. Goldin and RSA Director General Yuri Koptev at the end of the U.S.-Russia Joint Commission on Economic and Technological Cooperation meeting headed by Vice President Gore and Prime Minister Chernomyrdin. (NASA Release 94-101; AP, Jun 23/94; *P Inq*, Jun 24/94; *C Trib*, Jun 24/94)

- NASA and the Federal Aviation Administration announced their joint sponsorship of a general aviation design competition for students at U.S. aeronautical and engineering universities. Teams of graduate and undergraduate students, working with faculty advisers, were to develop a multidisciplinary design for a general aviation aircraft. (NASA Release 94-102)

June 24: Alumni of the Aerospace Human Factors Division office of NASA's Ames Research Center at Moffett Field, south of San Francisco, reportedly were exerting pressure to maintain the division as a separate entity in the restructuring taking place under new director Ken K. Munechika. These alumni had prominent positions in the airline industry, aircraft manufacturing, and government. Moreover, NASA created human factors research and a human factors pioneer such as John Lauber, of the National Transportation Safety Board, maintained that a separate organizational structure, combining computer sciences, engineering, psychology, medicine, and other disciplines, was essential. (*W Post*, Jun 24/94)

- NASA Administrator Daniel S. Goldin stated that the "GAO report is a validation of what we've been saying for months—Russian participation in

the Space Station is a good deal for the American taxpayer.” Goldin added that it would save hundreds of millions of dollars. He was “particularly pleased with the GAO’s positive assessment of how valuable the Russian contribution will be in terms of significantly improving the capability for science and engineering research.” Other benefits of Russian cooperation included completing the Space Station 15 months earlier than otherwise would be possible. (NASA Release 94-103; AP, Jun 24/94; Reuters, Jun 24/94)

- “Destiny in Space,” the latest IMAX space film, being shown in Langley Theater in the National Air and Space Museum, took viewers on a 40-minute high-tech space ride that examines space exploration by astronauts and robots. (*Journal*, Jun 24/94)

June 27: In an interview with NASA Administrator Daniel S. Goldin concerning dangers to the proposed Space Station from man-made space junk, he said the danger of debris smashing through the Station shield was 20 percent over its expected 10-year life and that NASA would do whatever was necessary to get adequate safety. Because of the lengthy period the Space Station was scheduled to spend in space, the danger was greater than for a single Shuttle flight. William M. Shepherd, Deputy Manager for the Johnson Space Center in Houston, said that each module for astronauts was getting about 3,000 pounds of added shielding to help protect it from the greater velocity of orbiting junk. Goldin asserted that an international agreement for controlling the contamination of space was needed to deal with the situation. (*NY Times*, Jun 27/94; *USA Today*, Jun 27/94; *C Trib*, Jun 27/94; *Fla Today*, Jun 28/94)

- NASA announced that the Ulysses spacecraft had become the first robotic exploration vehicle in history to reach a polar region of the Sun when it passed over the Sun’s southern polar area June 26 after a journey of almost four years from Earth. The European Space Agency built Ulysses, and Space Shuttle Discovery deployed it in October 1990. In February 1992, Ulysses spent nearly 11 days exploring unknown regions of Jupiter before it gained enough momentum to loop into an orbit that passed over the poles of the Sun. The Sun has a global magnetic field and magnetic poles, but many details concerning the polar caps and magnetic fields, including the influence of incoming cosmic rays, remain unclear. (NASA Release 94-104; *Fla Today*, Jun 29/94)

- An unmanned DC-X (Delta Clipper Experimental) rocket made an emergency landing at the White Sands Missile Range following a mysterious explosion soon after its engines started. The Ballistic Missile Defense Organization developed the missile, and McDonnell Douglas Corporation manufactured it. The flight was the fifth for the unusual rocket, which was made to take off and land vertically. The DC-X was grounded in the fall of 1993 when the project ran out of money. However, NASA came up with enough funds to keep the

program going until Congress appropriated \$5 million to complete its flight test program. Ultimately, the rocket was to be turned over to NASA. (*NY Times*, Jun 28/94)

June 28: In preparation for commemorating the 25th anniversary of Neil A. Armstrong's walk on the Moon on July 20, 1969, the media featured various articles, books, films, television specials, and high-level conferences on the meaning of the Moon landing. One article commented on the significance of these publications and events, with particular reference to *Moon Shot*, a memoir cowritten by Alan B. Shepard Jr. and the late astronaut Deke Slayton. (*LA Times*, Jun 28/94)

- NASA announced that Suzanne Smrekar, a geophysicist at NASA's Jet Propulsion Laboratory in Pasadena, California, who had been working on data from NASA's Magellan mission, had found that the planet Venus was still geologically active in places, even though radar images of its surface indicated little change in the past half-billion years. Data suggested that there were at least two, and possibly more, active hot spots on Venus. (NASA Release 94-105)

June 29: NASA Administrator Daniel S. Goldin issued a statement hailing the vote in the House of Representatives that defeated an amendment to end the Space Station program. In his statement, he expressed appreciation for the leadership of the President, the efforts of the Vice President, and the hard work of Chairman Brown and Representative Walker. He also praised the collaboration of NASA with international partners, which strengthened the U.S. space program. (NASA Release 94-106)

- The House by a 278 to 155 vote rejected the amendment that would have ended the Space Station program the next fiscal year and redirected \$2.1 billion in proposed funding to other NASA programs. A key factor in building support was the Station's foreign policy significance as a result of bringing Russia in as a Station partner. Intense lobbying efforts by the Clinton administration also were a factor. (Reuters, Jun 29/94; AP, Jun 29/94; UP, Jun 29/94; *WSJ*, Jun 30/94; *P Inq*, Jun 30/94; *W Post*, Jun 30/94; *USA Today*, Jun 30/94; *W Times*, Jun 30/94; *Fla Today*, Jun 30/94; *Fla Today*, Jul 1/94; *C Trib*, Jul 5/94)

June 30: NASA announced that based on technology developed for its Hubble Space Telescope, a new, non-surgical breast biopsy technique had been developed. The new technique, known as stereotactic large-core needle biopsy, was predicted to reduce national health care costs by about \$1 billion annually. The technique involved an improvement to digital imaging technology called a Charge Coupled Device, a high tech silicon chip that converted light directly into an electronic image. (NASA Release 94-107)

July

July 1: Stu Grissom, manager for project development of hardware at NASA's Johnson Space Center, said NASA was evaluating mechanical difficulties with a Russian-made docking device critical to plans for a first linking of a Space Shuttle to the Mir Space Station in mid-1995. NASA was surprised to learn earlier that the Mir side of the docking device had explosive charges on only the active hooks whereas the Shuttle side had charges on both the active and passive mechanisms. The second problem was the failure of a laboratory version of the Shuttle/Mir docking mechanism to fully pass two of five cold temperature runs in June at NPO Energia (a subcontractor to Rockwell International) facilities in Russia. The failure, which was being investigated, might be the result of the quality of lubricant used. (*H Chron*, Jul 2/94; *H Post*, Jul 2/94; *AvWk*, Jul 4/94)

July 3: Itar-Tass news agency reported that a Russian spaceship manned by a Russian and a Kazakh cosmonaut had docked with Mir. (*H Post*, Jul 4/94)

- The nature of experiments scheduled to be performed by astronauts aboard Space Shuttle Columbia in its forthcoming flight was described. In the field of life sciences, the experiments were intended to reveal the role gravity played in the reproduction and early development of plants and animals. In the second area, materials science, in the absence of gravity, engineers hoped to show a potential for forging strong, new metal alloys, high-speed semiconductors, and other components for use in aerospace and electronic products. (*H Chron*, Jul 3/94)

- An article about U.S. astronauts Norman Thagard and Bonnie Dunbar and their training in Russia stressed their intensive Russian language lessons and their sense of Russia's space program accomplishments in the face of the country's serious economic problems. They believe both countries would benefit from space cooperation: the United States would gain from the experience and data Russia had collected from long stays in space and Russia would profit from U.S. technology and the use of the U.S. Shuttle to ferry large cargos to Mir. (*C Trib*, Jul 3/94)

- The condition of the Russian space program was described in view of Russia's new space cooperation with the United States. Russian policy was to activate the control center for Space Station Mir only when the ground was in contact with Mir. Otherwise the center was closed and personnel returned to their primary employment: moonlighting jobs. The primary Russian contractor on the Space Station, NPO Energia, had made progress toward privatization, but upper management remained committed to the traditional Soviet pattern of secrecy and exclusion of outside supervision. (*O Sen Star*, Jul 3/94)

- In connection with the upcoming 25th anniversary of the first moonwalk, NASA's current role and the ways it had changed from earlier days were assessed. Among the differences noted were the emphasis on science rather than the ability to engineer space travel, global teamwork rather than a race to beat the communists, and the stress on "smaller, cheaper, faster, better" as NASA's new motto. (*P Inq*, Jul 3/94)

July 5: The approaching 25th anniversary of the first Moon landing by Neil Armstrong occasioned a feature article on Gene Kranz, NASA Flight Director, who enabled the operation to occur. (*LA Times*, Jul 5/94)

- The countdown began for the launch of Shuttle Columbia scheduled for July 8. (*W Times*, Jul 6/94; *USA Today*, Jul 6/94)

July 6: The pressure on California's space firms to adapt to a new mission, survival, in view of congressional budgetcutting and constant funding problems was highlighted. The role of commercial firms in the space industry as opposed to NASA was raised as was the fact that the space program no longer revolved around competition with the Soviet Union. (*LA Times*, Jul 6/94)

- NASA announced that astronaut Richard O. Covey would leave NASA as of July 11 and would retire from the Air Force on August 1. He was scheduled to become director of Business Development at Calspan Services Contracts Division, a part of Space Industries, Inc. (NASA Release 94-110)

- NASA announced its selection of Brown & Root Services Corporation, Houston, as a contractor to provide minor construction, modification, and rehabilitation to NASA Goddard Space Flight Center, Greenbelt, Maryland. (NASA Release C94-y)

- NASA announced that an international team of astronomers had used the European Space Agency's Faint Object Camera on the Hubble Space Telescope to confirm a prediction of the Big Bang theory—that helium should be widespread in the early universe. The July 7 issue of the British science journal *Nature* reported the way in which the helium was detected. (NASA Release 94-109)

- NASA announced that it would negotiate contracts with 15 small companies to enable them to fully develop innovative new high technology products they had proposed for application in the aerospace industry. The contracts would be financed under NASA's Small Business Technology Transfer Program. (NASA Release 94-111)

- NASA announced members of the crew for the second Wake Shield Facility Shuttle flight aboard Endeavour, scheduled for mid-1995, under the command of David M. Walker. (NASA Release 94-112)

July 8: NASA announced the selection of two Space Grant Consortiums: Virginia and Colorado, and two universities: the University of Pennsylvania and the University of Cincinnati, to participate in the Student Launch Program. The program was intended to provide undergraduate students hands-on experience in flying space and Earth science experiments on sub-orbital sounding rockets and scientific balloons. (NASA Release 94-113)

- NASA announced that in August 1994 scientists would have a chance to study how the Earth's global environment was changing when Space Shuttle Endeavour began its 10-day mission, carrying the Space Radar Laboratory on its second flight. The mission, which would feature various international scientific experiments, would be under the command of Michael A. Baker. (NASA Release 94-114)

- Space Shuttle Columbia lifted off on schedule, and the seven astronauts, including the first Japanese woman in space, began their experiments. The embryonic newts were thriving, and the adult female newts had produced additional eggs. The astronauts also began performing tests to determine how their bodies were adapting to weightlessness. One effect of the absence of gravity was that astronauts tended to grow two or more inches in space because of an elongated spine; they would revert to normal height on Earth. Findings could help in treating back pain on Earth. Among the animals carried for experimental purposes were four pregnant newts. By July 17, the second newt had died for an undetermined reason. The scientists also levitated a pea-sized drop of gold inside an electromagnetic field to investigate ways to exploit the absence of gravity in manufacturing. The astronauts worked in two shifts around the clock in order to complete all but one of the planned 82 experiments. A blown fuse in the French-built electrophoresis unit kept the astronauts from conducting their final experiment before preparing to return to Earth. On July 20, the astronauts marked the 25th anniversary of the Moon landing. Because of heavy rainstorms, the projected landing on July 22 was postponed; because of the delay, the mission set a new Space Shuttle flight duration record. In the course of the flight, a number of the eggs hatched, and scores of eggs were laid by the various animals aboard. (*B Sun*, Jul 9/94; *C Trib*, Jul 9/94; *NY Times*, Jul 9/94; *W Post*, Jul 9/94; *W Times*, Jul 9/94; Reuters, Jul 9/94; *B Sun*, Jul 10/94; *W Post*, Jul 10/94; AP, Jul 10/94; UP, Jul 10/94; Reuters, Jul 10/94; *USA Today*, Jul 11/94; *W Times*, Jul 11/94; AP, Jul 11/94; Reuters, Jul 11/94; *B Sun*, Jul 12/94; *W Post*, Jul 12/94; *USA Today*, Jul 12/94; AP, Jul 12/94; Reuters, Jul 18/94; UP, Jul 18/94; Reuters, Jul 18/94; *NY Times*, Jul 19/94; *USA Today*, Jul 19/94; *W Post*, Jul 19/94; AP, Jul 19/94; UP, Jul 20/94; AP, Jul 20/94; AP, Jul 22/94; UP, Jul 22/94; Reuters, Jul 22/94)

July 9: Itar-Tass news agency reported that two Russian cosmonauts had returned to Earth near Arkalyk, Kazakhstan, after nearly six months on board Space Station Mir. They left behind a colleague who intended to break the

current record of 366 consecutive days spent in space by remaining on Mir 429 days. (*B Sun*, Jul 9/94; *AP*, Jul 9/94)

July 10: A lengthy review of the four-hour TBS documentary film "Moon Shot," described the extraordinary footage obtained from NASA, primarily from the Johnson Space Center, and the story behind the U.S. 10-year race to beat the Soviet Union to the Moon. (*TV Times*, Jul 10-16/94)

- Various special television programs were scheduled to commemorate the 25th anniversary of the Moon landing. In addition, the press planned to feature accounts recalling events of the first Moonwalk. (*B Sun*, Jul 10/94; *C Trib*, Jul 10/94; *LA Times*, Jul 10/94; *AP*, Jul 10/94; *USA Today*, Jul 11/94; *W Post*, Jul 11/94; *AP*, Jul 11/94)

July 11: In connection with the July 16 projected smashing into Jupiter of fragments of the comet Shoemaker-Levy 9 at a speed of about 130,000 miles an hour, numerous media presentations appeared. Although collisions were scheduled to occur on the far side of Jupiter, the impact sites should rotate into view in less than an hour, so lasting effects could be studied by observatories on Earth and by NASA's crippled Galileo spacecraft. NASA was setting up an around-the-clock Comet Impact Newsroom at Goddard Space Flight Center to assist scientists interpreting the event. (*SP News*, Jul 11-17/94; *LA Times*, Jul 11/94; *NY Times*, Jul 12/94; *LA Times*, Jul 12/94; *USA Today*, Jul 12/94; *Reuters*, Jul 12/94)

- The National Research Council reported that NASA officials had not yet established a solid working relationship with the Russian Space Agency. The Council found tremendous improvement in NASA management but considered that NASA thus far lacked a strong grip on Russian involvement. Since 1985, the Council, the operating arm of the National Academy of Science and the National Academy of Engineering, had reviewed the Space Station regularly under Federal funding. The Space Station Committee, headed by Jack Kerrebrock, a Massachusetts Institute of Technology professor, also expressed concern that NASA needed to invest more in experiment development and preparatory work on Spacelab, the Shuttle's science laboratory. (*SP News*, Jul 11-17/94; *NY Times*, Jul 29/94; *Phillips Business Information*, Jul 29/94)

- Officials at NASA, Los Alamos National Laboratory in New Mexico, and the Jet Propulsion Laboratory in Pasadena, California, said mission designers were being discouraged from including Radioisotope Thermoelectric Generators (RTGs) in future satellites. RTGs were plutonium-powered and were used most frequently on spacecraft traveling beyond Earth's orbit because solar panels became increasingly less efficient the farther they were from the Sun. Scientists and engineers planning NASA's proposed Pluto Fast Flyby mission wanted to use an RTG, but thus far approval had been refused. The scientists were concerned that NASA was becoming anti-nuclear, but NASA

officials and the White House denied there was a policy decision to end the use of RTGs. In late June, a Technology Challenge team headed by Dwight Duston, director of science and technology for the Ballistic Missile Defense Organization, "unanimously recommended the use of an RTG without reservation" for the Pluto Fast Flyby. (*SP News*, Jul 11-17/94)

July 12: A feature article described the training program in Russia of U.S. astronauts Norman Thagard and Bonnie Dunbar. Thagard was scheduled to blast off to Russian Space Station Mir with two cosmonauts in March 1995; Dunbar was his backup. They were studying Russian intensively, both the spoken language and technical terminology. In addition, they practiced on a Soyuz simulator, conducted serious physical workouts, and engaged in Russian psychological training for long-haul space crews. (*LA Times*, Jul 12/94)

- NASA announced that astronaut William F. Readdy would replace Kenneth D. Cameron as NASA manager of operational activities at Star City, Russia. As Director of Operations, Russia, Readdy would work with Russian trainers, engineers, and flight controllers to support the training of NASA astronauts at Gagarin Cosmonaut Training Center, Star City, and to enhance continued cooperation between NASA and Russia's Space Agency. (NASA Release 94-115)

July 13: NASA announced the appointment of Brian Welch as Chief of News and Information at NASA Headquarters, Washington, DC. (NASA Release 94-116)

July 14: NASA announced the selection of a team led by Lockheed Space Operations, Inc., Titusville, Florida, for a contract to provide propulsion test and technical services at the John C. Stennis Space Center in Hancock County, Mississippi. (NASA Release C94-aa)

July 15: NASA announced that the Space Station Control Board had approved a revised assembly sequence that provided significantly more power for the U.S. laboratory, provided an earlier U.S. capability for essential Space Station systems, and produced hardware in an efficient and cost effective manner while still meeting the \$2.1 billion annual spending cap. (NASA Release 94-117)

- NASA announced the award of a \$440 million contract to Boeing Commercial Airplane Group, Seattle, Washington, with McDonnell Douglas Aerospace, Long Beach, California, and other companies to develop airframe technologies for aerodynamics, flight systems, and materials and structures. The award marked the first time the two leading U.S. airplane manufacturers would have teamed up to develop technologies for a potential future U.S. High-Speed Civil Transport. (NASA Release 94-118)

July 16: An article discussed finding other planetary systems as an inspiring new challenge for astronomy and pointed out NASA Administrator Daniel S. Goldin's proposal that NASA's core mission might be the search for a habitable planet. Mention was made of Proxima Centauri, the nearest neighbor of a bigger, hotter, brighter star: the Sun, which made it an easy star around which to look for planets. NASA's Hubble Space Telescope was used to study Proxima Centauri and recently the Hubble discovered discs in the Orion nebula, which might produce planetary systems. Although the search for extraterrestrial intelligence (SETI) was eliminated by Congress, SETI continued with private money and became Project Phoenix, scheduled to be connected with the Parkes radio telescope in Australia in early 1995 and to listen for faint radio signals from hundreds of stars. (*Economist*, Jul 16/94)

July 17: A biography of NASA Administrator Daniel S. Goldin based on an interview with him, said that Goldin put in 15-hour days; originally, he did this seven days a week but now he did it five and a half days a week. In returning to NASA from TRW, he determined to battle the bureaucracy and did so. He expressed concern about America having become a nation of consumption, interested mainly in entertainment and recreation. His major present concern was keeping the Space Station on track. (*News Register*, Jul 17/94)

July 18: NASA announced that it and the National Space Agency of Ukraine (NSAU) had agreed July 13 to explore possible cooperation in remote sensing and Earth sciences, telemedicine, space biology, space welding, advanced concepts and technology, and student and scientist exchanges. Robert W. Clarke, NASA Associate Administrator for Policy Coordination and International Relations, headed the U.S. delegation and Valeriy G. Komarov, Deputy Director General of NSAU, headed the Ukrainian delegation. (NASA Release 94-119)

- The impact of a huge Fragment G, a two-mile-wide piece of Comet Shoemaker-Levy 9, was as great as six million megatons of TNT when it hit Jupiter early July 18, according to NASA's Goddard Space Flight Center. A similar piece hit late July 18, and a further piece was expected on July 20. In contrast, the total energy that could be created on Earth with atomic bombs was 10,000 megatons. The comet left a scar larger than Earth's diameter on Jupiter's gaseous surface. Scientists began to study the long-term effects on Jupiter of the comet's impact. The media also focused on the work of NASA's Goddard Space Flight Center, Greenbelt, Maryland, in tracking developments on Jupiter and the excellent view of Jupiter for astronomers at the South Pole. In the final stage of the comet barrage that ended late July 21, four large comet fragments hit Jupiter, creating tremendous fireworks for watching astronomers. Furthermore, as a result of the scars made by the fragments, white hot gases from the planet's interior erupted through the holes in great fireballs. In measuring the dazzling light produced, astronomers believed they

had detected hydrogen sulfide, which could contribute to Jupiter's colors. The potential dangers associated with the comet collision with Jupiter led the House Committee on Science, Space, and Technology to propose legislation that, if passed, would direct NASA to submit a plan by February 1995 for a 10-year program to catalog "all comets and asteroids that are greater than one kilometer in diameter" traveling along orbits that intersect that of the Earth. (*LA Times*, Jul 18/94; *C Trib*, Jul 18/94; *LA Times*, Jul 19/94; *W Post*, Jul 19/94; *W Times*, Jul 19/94; *USA Today*, Jul 19/94; *B Sun*, Jul 19/94; *C Trib*, Jul 19/94; *NY Times*, Jul 20/94; *USA Today*, Jul 20/94; *W Times*, Jul 20/94; *LA Times*, Jul 20/94; *B Sun*, Jul 20/94; *CSM*, Jul 20/94; *C Trib*, Jul 20/94; *P Inq*, Jul 20/94; *NY Times*, Jul 21/94; *USA Today*, Jul 21/94; *B Sun*, Jul 21/94; *LA Times*, Jul 21/94; *C Trib*, Jul 21/94; *P Inq*, Jul 21/94; *LA Times*, Jul 22/94; *NY Times*, Jul 22/94; *W Post*, Jul 22/94; *B Sun*, Jul 22/94; *USA Today*, Jul 22/94; *W Times*, Jul 22/94; *Time*, Jul 25/94; *LA Times*, Jul 26/94; *NY Times*, Jul 26/94; *USA Today*, Jul 26/94; *CSM*, Jul 28/94; *NY Times*, Aug 1/94)

- Astronaut Neil Armstrong made a rare public appearance at an airshow in New Knoxville, spoke briefly to reporters and signed autographs. He said he had accepted an invitation to the White House on the 25th anniversary of his Moon walk. (*Western Star*, Jul 20/94)

July 19: A feature article on NASA stated that cooperation with the Russians in space was an important foreign policy initiative of the Clinton administration. In this connection, NASA was working hard at merging many of its programs with those of Russia, as NASA Administrator Daniel S. Goldin indicated in a recent interview. (*NY Times*, Jul 19/94)

- Roger Bonnet, science director of the European Space Agency (ESA), stated in an interview that the ESA, a consortium of scientists from 14 countries, sought some \$350 million from member states to fund the first in a series of lunar programs that could end in a manned Moon station within 25 years. The first European emissary to the Moon, a small, unmanned craft named LEDA (Lunar European Demonstration Approach), could land on the Moon by 2001. LEDA would carry instruments to measure the darkness of the lunar sky, the frequency of meteorite impacts, and the stability of the ground, factors that would affect the functioning of a future astronomical observatory. LEDA would also need to analyze lunar soil for components to be used in the construction and operation of a permanent station. Such a European approach would bypass NASA's plans for an orbiting Space Station, a plan with which many European countries had become disenchanted. (*NY Times*, Jul 19/94)

- Fifty-four minority high school students, mostly African Americans, from the Los Angeles area, began a four-week stay at Central State University in Wilberforce, Ohio, studying computer science, Earth sciences, and mathematics. NASA sponsored the \$300,000 Earth to L.A. program in order to

encourage minority students to pursue such courses at traditionally black colleges and universities. Following the courses at Central State, the students would spend two weeks visiting 12 black colleges, looking toward future college entrance. (*LA Times*, Jul 21/94)

July 20: NASA announced that as of July 25 it would no longer distribute news releases or contract announcements by mail. Instead it would use electronic distribution services. (NASA Release 94-121; *P Inq*, Jul 29/94)

- A biographic account of NASA Administrator Daniel S. Goldin stressed his enthusiasm for sending humans into space combined with a tremendous work ethic. As an administrator at aerospace manufacturer TRW, he developed strong ideas about what was wrong with the space program and how to fix it. Space advisers to President George Bush found NASA unresponsive to change and decided to offer the NASA Administrator's job to Goldin. Among his management tools, Goldin said, was the creative use of chaos. (*W Post*, Jul 20/94)

- Senator Barbara Mikulski, Democrat from Maryland, described some of the benefits Americans enjoyed in their daily lives that resulted from space-based research. Among these were insulation techniques used by Meals on Wheels to deliver food to senior citizens, miniaturization and computers, laser technology for use in the information superhighway, and biomedical discoveries. The latter included laser systems used in heart treatment, pacemakers, and body imaging techniques used in breast cancer detection. In addition, the space program created thousands of jobs. Despite the above achievements, Mikulski admitted that NASA in the past had over-promised technology and underestimated cost. NASA needed a clear set of priorities, and space programs must become multinational. (*W Post*, Jul 20/94)

- The 25th anniversary of the first Moonwalk was the occasion of several articles looking back at the excitement of that event and subsequent developments as well as an assessment of the current status of the space program. Noting that one-third of the U.S. population was not alive in 1969, the articles especially remarked upon a lack of enthusiasm about space, together with concern about earthly matters. Neil Armstrong's role in the Moon landing and the fact that he never became a public hero also was touched upon. (*W Post*, Jul 20/94; *NY Times*, Jul 20/94; *USA Today*, Jul 20/94; *C Trib*, Jul 20/94; *WSJ*, Jul 20/94; *LA Times*, Jul 21/94; *H Post*, Jul 22/94; *P Inq*, Jul 22/94)

- On the 25th anniversary of the Moon landing, President Clinton and Vice President Gore welcomed the three Apollo 11 astronauts: Neil Armstrong, Edwin "Buzz" Aldrin, and Michael Collins, at a White House ceremony. The U.S. Post Office also issued a stamp commemorating the 1969 event. (*UP*, Jul 20/94; *Reuters*, Jul 20/94; *W Post*, Jul 21/94; *NY Times*, Jul 21/94; *B Sun*, Jul 21/94; *USA Today*, Jul 21/94; *P Inq*, Jul 21/94; *LA Times*, Jul 21/94)

- NASA and Carnegie Mellon University scientists gave a preliminary test to an eight-legged robot name Dante II. They sent it down a gravel quarry to test the \$1.8 million robot's satellite and fiber-optics links and software. On July 22, or soon thereafter, they planned to send it down Mount Spurr, an active volcano 80 miles west of Anchorage. Such robots would be useful in extreme terrains and climates. On July 28 a NASA scientist, Butler Hine, said that a communications problem resulting from a poor satellite link with the robot was delaying the robot's mission into the volcano. The robot took its first steps on July 29 and was scheduled to walk 12 hours a day. By late on July 31, the robot was about 150 feet from its goal, a field of volcanic vents on the bottom of the crater. As of August 2, the robot was sending back valuable scientific data from inside the crater, despite being hit by a falling rock. On August 3, Dante II began its steep walk out of the crater. The climb halted on August 4 because of a faulty power unit on the crater rim. Scientists fixed the electrical problem but on August 6 the robot fell on its side. Possible methods for retrieving the robot were under consideration. An attempt to airlift the robot by helicopter on August 9 failed when the cable snapped, dropping Dante II further down the crater. On August 13, two experienced climbers climbed into the crater and manually wrapped a sling around the robot and attached it to a line from the helicopter, which then pulled Dante II up. (AP, Jul 21/94; AP, Jul 26/94; *USA Today*, Jul 27/94; Reuters, Jul 28/94; *NY Times*, Jul 30/94; AP, Jul 30/94; *W Times*, Jul 31/94; *C Trib*, Jul 31/94; *NY Times*, Aug 2/94; Reuters, Aug 2/94; AP, Aug 2/94; AP, Aug 3/94; AP, Aug 4/94; Reuters, Aug 4/94; *USA Today*, Aug 5/94; Reuters, Aug 6/94; *USA Today*, Aug 8/94; *NY Times*, Aug 9/94; *USA Today*, Aug 9/94; AP, Aug 9/94; Reuters, Aug 9/94; *B Sun*, Aug 10/94; *W Post*, Aug 10/94; AP, Aug 10/94; *Chronicle of Higher Education*, Aug 10/94; AP, Aug 13/94; Reuters, Aug 14/94; *W Post*, Aug 15/94; *NY Times*, Aug 15/94; *USA Today*, Aug 15/94; *CSM*, Aug 15/94; *Time*, Aug 15/94; *AvWk*, Aug 15/94; *Chemical and Engineering News*, Aug 15/94; AP, Aug 22/94; *LA Times*, Aug 28/94)

July 21: NASA announced that of the various devices left by astronauts Neil Armstrong and Buzz Aldrin on the Moon 25 years ago, a laser ranging retro-reflector continued to provide fundamental scientific data. From the data obtained and new observations, scientists now believed that the Moon might have a liquid core. Among other findings from the laser ranging experiments were a verification of Einstein's theory of relativity and the direct influence on the Moon's orbit of ocean tides on Earth. (NASA Release 94-122)

- The Italian Foreign Ministry announced that Italy and the United States would launch a spacecraft in October 1997 on a seven-year voyage to Saturn. The Cassini would leave a special probe, called Huygens, on the surface of Saturn's largest moon, Titan, to gather data on the atmosphere, magnetosphere, and chemical make-up of the rings of Saturn and the movements of its satellites. An agreement to conduct the mission, which was being developed

by NASA and the Italian Space Agency, was signed by Italian Foreign Minister Antonio Martini and U.S. Ambassador to Italy, Reginald Bartholomew. (Reuters, Jul 21/94)

July 25: The National Full-Scale Aerodynamics Complex (NFAC), the world's largest wind tunnel, turned 50 in 1994. The NFAC, located on 12 acres of NASA's Ames Research Center in Moffett Field, California, tested World War II aircraft and continued to operate by testing the Space Shuttle and other aircraft and equipment. (UPI, Jul 25/94)

- Scottsdale, Arizona, received \$750,000 in grants from NASA and the Department of Energy to use multispectral imaging to map and study the nearby McDowell Mountains. In August, a Learjet provided by NASA and equipped with instruments that measured light ranging from infrared to ultraviolet was scheduled to be flown over the McDowells. The remote sensing system would permit a precise study of all that composes the mountain range and would be used to produce a three-dimensional map. NASA made the system available for civilian use, and Scottsdale was the first city to take advantage of the possibility. (*Arizona Republic*, Jul 25/94)

July 26: NASA announced that scientists at its Ames Research Center, Moffett Field, California, and the New York Medical College (NYMC) in Valhalla, New York, were using satellite remote sensing and computer technology to predict the risk of Lyme disease transmission. The NASA team, working with Dr. Durland Fish of NYMC and Westchester County Health Department investigators, found that the higher the proportion of vegetated residential area next to woods within a municipality, the higher the transmission risk. (NASA Release 94-123)

- NASA announced that it had recorded on video for the first time hundreds of spectacular red and blue flashes of light that extended upward from electrical thunderstorms to altitudes as high as 60 miles. The flashes occurred over thunderstorms in the Midwest between June 28 and July 12 during a NASA-sponsored investigation into the phenomenon. The principal investigators were two University of Alaska, Fairbanks professors, Davis Sentman and Eugene Wescott, who used special low-light-level cameras aboard two jet aircraft flown out of Oklahoma City. (NASA Release 94-124; *W Post*, Aug 1/94)

July 27: In a hearing of the House Energy and Commerce Committee, chairman John Dingell, Democrat from Michigan, pressed NASA officials to explain why they had selected Boeing as prime contractor for the Space Station in late 1993 in spite of the firm's having failed NASA's own cost-control reviews. NASA officials admitted they did not know that Boeing was under 21 federal criminal investigations and was forced to pay the government \$161 million in settlements. Testifying for NASA were Deidre A. Lee,

Associate Administrator for Procurements, and Deputy Administrator John R. Dailey. In addition to the problems with Boeing, Michael Thibault, Assistant Director of the Defense Contract Audit Agency, said that an audit of charges by IBM, a subcontractor to McDonnell Douglas, one of the earlier Space Station contractors, found that about 20 percent of IBM's \$490 million charges were not allowable under its contract. (*LA Times*, Jul 28/94; *SP News*, Aug 1-7/94)

July 28: Scientists at NASA's Jet Propulsion Laboratory in Pasadena, California, released photos of the Chicxulub crater on the Yucatan peninsula in Mexico. The photos, taken from NASA's spaceborne radar, showed the site where scientists considered an impact 65 million years ago might have caused climatic changes that killed the dinosaurs. (*USA Today*, Jul 29/94)

July 29: NASA agreed to launch in January 1996 South Africa's first satellite, Sunsat, which was developed at Stellenbosch University near Cape Town. A four-member NASA team evaluated the Stellenbosch project and offered the university a free launch in return for minor additions of U.S. equipment. Stellenbosch project leader Garth Milne said the satellite would deliver high-resolution multispectral stereo images of the Earth and would carry amateur radio equipment that would allow children to talk to the satellite. NASA structural engineer Marisa Achee said NASA was keen to launch Sunsat because it could carry a U.S. Global Positioning System receiver and a laser reflector needed to monitor variations in the Earth's gravitational field. The university was scheduled to control the satellite during its four-year life. (Reuters, Jul 29/94)

July 30: The official newspaper, *China Daily*, quoted a spokesperson for the China Aerospace Corporation as expressing confidence it would fulfill all launch services for overseas clients in 1994. China launched the Apstar-1 satellite made by U.S. Hughes Aircraft, from the Xichang Space Center in southwest China on July 21. An Australian satellite was scheduled to be launched in August. China sought a larger share of the commercial space market dominated by NASA, Europe's Arianespace, and Russian launchers. (UPI, Jul 30/94)

July/August: A lengthy interview with NASA Administrator Daniel S. Goldin stressed his emphasis on the future rather than NASA's past. In this connection, he concentrated on four objectives: determine how people could live and work productively in space, how to do this on an international basis, improve systems management in order to accomplish these objectives in eight years, and America must regain its self-confidence. Goldin believed all these objectives could be accomplished by creating the International Space Station. (*Final Frontier*, Jul/Aug 94)

August

August 1: *Space News* reported on the financial and other difficulties confronting the Russian space program. Few of the staff of the Russian Space Agency (RSA) were receiving pay checks; many space workers were on unpaid leave and other scientists and engineers had left RSA; unlike NASA, RSA had oversight responsibility but did not manage space projects, leading to power struggles with companies engaged in space work and with the military with whom RSA must negotiate such matters as rental fees for using military facilities for launches. (*SP News*, Aug 1-7/94)

- NASA announced that its Marshall Space Flight Center in Huntsville, Alabama, had signed an agreement with McDonnell Douglas Aerospace in Huntington Beach, California, to reconfigure the Delta Clipper experimental vehicle (DC-X) using advanced lightweight materials and advanced auxiliary propulsion systems. NASA was acquiring the DC-X from the Department of Defense to test new technologies needed to develop a reusable launch vehicle that could assist NASA's ultimate goal of gaining low-cost access to space. (NASA Release 94-125)

- NASA announced that it would conduct a joint campaign with Brazilian space agencies to study the Earth's space environment over the magnetic equator from August 15 through October 20, 1994, as part of the International Equatorial Electrojet Year. During the campaign, NASA's Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Virginia, was scheduled to launch 33 rockets from the Centro de Lançamento de Alcântara launch range in the northeastern state of Maranhão, Brazil. (NASA Release 94-126)

- NASA was experiencing difficulties finding sufficient amounts of materials to fill the Shuttle's cargo bay in order to justify a planned ten Shuttle flights to Russian Space Station Mir. It might develop that only six or seven flights would be needed according to NASA Shuttle Chief Bryan O'Connor. (Phillips Business Information, Aug 1/94)

August 2: The General Accounting Office issued a report to the Congress stating that Russian participation in the U.S. Space Station project would add nearly \$400 million to the Station's cost as well as \$1.4 billion for other NASA programs that supported the Station, instead of saving that amount, as had been predicted. (*Reuters*, Aug 2/94; *P Inq*, Aug 3/94; *AP*, Aug 3/94)

August 3: The Senate voted 64 to 36 to defeat the amendment offered by Senator Dale Bumpers, Democrat from Arkansas, to end funding for the International Space Station. (*W Post*, Aug 4/94; *W Times*, Aug 4/94; *Huntsville News*, Aug 4/94)

- NASA Administrator Daniel S. Goldin issued a statement following the defeat of the Senate amendment to end funding for the International Space Station. Goldin praised the Senate's vote of confidence as an indication of a bipartisan coalition of support. He said that the Space Station was a "truly international scientific effort, and a powerful symbol of peaceful cooperation in the post Cold War world." Subsequent to Goldin's statement, various media comments appeared stressing the commitment of "time and political capital" by the President and the Vice President to supporting the Space Station, in addition to Goldin's tireless efforts. (NASA Release 94-127; *SP News*, Aug 8-14/94; *B Sun*, Aug 12/94)

- NASA announced the establishment of a committee to develop a plan to identify and catalogue, to the extent practicable within 10 years, all comets and asteroids that might threaten the Earth. Eugene Shoemaker, an astronomer with the Lowell Observatory, was appointed chairman of the eight-member Near-Earth Object Search Committee. The committee was formed in response to congressional direction to NASA to develop a plan in coordination with the Department of Defense and the space agencies of other countries. Gregory Benford, professor of physics at the University of California, Irvine, commented on the congressional charge by saying that publicizing such tracking would be an opportunity for NASA for "smart public relations and smart science." (NASA Release 94-128; *LA Times*, Aug 21/94; *B Sun*, Aug 24/94)

- NASA announced its selection of NSI Technology Services of Sunnyvale, California, for a contract to provide engineering, technical, logistical, and administrative technical services to support two airborne science aircraft at its Ames Research Center, Moffett Field, California. (NASA Release C94-bb)

- A NASA B-52 successfully launched a standard Pegasus booster carrying an Advanced Photovoltaic and Electronic Experiments (APEX) spacecraft, which Orbital Sciences Corporation had developed for the U.S. Air Force. APEX was the first satellite developed using Orbital's standard satellite platform and represented the first Pegasus mission that maximized the payload and weight capability of the standard booster. (*AvWk*, Aug 8/94)

August 4: NASA announced that astronaut Sidney M. Gutierrez would leave NASA effective August 8 and retire from the Air Force to become Manager for Strategic Planning and Development at Sandia National Laboratories in his hometown of Albuquerque, New Mexico. (NASA Release 94-129)

- NASA stated that it planned to launch Space Shuttle Endeavour on August 18 for a 10-day Earth-monitoring mission. (*AP*, Aug 4/94; *Reuters*, Aug 4/94; *USA Today*, Aug 5/94)

August 7: Some 100 astronomers from around the world, including Tim Livengood from the Goddard Space Flight Center in Greenbelt, Maryland,

traveled to the European Southern Observatory at La Silla in the mountains of northern Chile, to view the collision of the comet with Jupiter in July. (*W Times*, Aug 7/94)

- An article on electronic navigation and the Global Positioning System (GPS) using 24 satellites described the advantages of GPS and its uses. The article reported that using GPS and a sophisticated flight computer aboard a 737 aircraft owned by NASA, more than 36 "hands-off" precision landings were completed at Wallops Island airfield in Virginia. (*C Trib*, Aug 7/94)

August 8: NASA announced the appointment of J. Stuart Fordyce, currently Deputy Director of NASA's Lewis Research Center, Cleveland, as Chief Scientist at the Ohio Aerospace Institute, Cleveland, effective September 18. (NASA Release 94-130)

- NASA announced the selection of BDM Federal, Inc., McLean, Virginia, to form a Remote Sensing Public Access Center for demonstrating, testing, and transferring technology to help provide public use of Earth and space science data over the Internet. (NASA Release 94-131; *Federal Computer Week*, Aug 22/94)

- The nature of Space Ship Endeavour's forthcoming mission, after its projected launch on August 18 was described. In comparison to the April flight that mapped vegetation across the globe, searched for ancient rivers and trade routes, and studied the world's oceans, the August flight, using the \$600-million Space Radar Laboratory, by taking the same trajectory was to compare seasonal variations and verify scientists' ability to interpret radar data. The first six days of the 10-day flight essentially were to be a near duplicate of the April flight. The last four days were to use the radar lab's instruments to perform interferometric measurements of the Earth's surface. Interferometry typically used multiple antennas to observe a single site, then calculated the difference in the returned signals to determine the distance to that site. Endeavour scientists hoped to achieve the same result by using their single set of radar to observe the same ground tracks from parallel orbits. They expected to have three opportunities to observe long ground tracks in North America and two for Central Africa, each for about 20 minutes. The operation would require expert navigation and flying to maintain a correct observation position within 850 meters. (*AvWk*, Aug 8/94)

- The requirements for Rockwell International's Space Systems Division in integrating a Russian-built mechanism into airlock hardware it had manufactured so Space Shuttle Atlantis could dock with Space Station Mir were described. The docking assembly would be the first in what could be a long line of hybrid U.S.-Russian space hardware. Rockwell executives were confident they could meet the May 1995 launch date for Atlantis. Rockwell's

Russian partner was NPO Energia, with whom it had worked some 20 years previously on the Apollo-Soyuz Test Project. Some of the complications of the collaboration were discussed. (*AvWk*, Aug 8/94)

- A Japanese cabinet advisory commission report stated that Japan needed to double its space budget over the next 15 years to initiate planetary expeditions, become a leader in Earth observation, and develop advanced robotics. The new space plan confirmed Japan's existing commitment to international space programs, including the Japanese Experiment Module for NASA's International Space Station. The recommendations came from a long-term planning group within the Space Activities Commission and were to be forwarded to Japan's Finance Ministry at the end of August when the fiscal 1995 budget would be prepared. (*AvWk*, Aug 8/94)

August 9: An article highlighted the benefits satellite reporting could provide for various earthly activities. An example given was the way in which Frank Lamb, president of Eastern Oregon Farming Company and Cropix, Inc., who had a grant from NASA's Earth Observation Commercialization Applications Program, used satellite observations to check on the health of plants in his Oregon farm by determining the rate of photosynthesis. The images enabled a farmer to detect problems such as irrigation-equipment failure, drainage problems, and pest infestation. Satellite images were also used by the South Florida Water Management District to update its maps and identify illegal tampering of wetlands, as well as to create maps of Midwest flood areas for damage and rebuilding plans. (*USA Today*, Aug 9/94)

- U.S. astronauts and Russian cosmonauts met at the 10th congress of the Association of Space Explorers that opened in Moscow. Participants stressed the importance of space cooperation now that the space race was over. The conference theme was devoted to protecting Earth's ecology. (*AP*, Aug 9/94)

August 10: NASA announced that the French space agency, Centre Nationale d'Etudes Spatiales (CNES) was awarding the U.S.-French TOPEX/Poseidon management team the CNES Medal in recognition of their achievements. Seven team members from NASA Headquarters, Washington, DC, NASA's Jet Propulsion Laboratory, Pasadena, California, and the CNES project office received the awards. Launched August 10, 1992, TOPEX/Poseidon continued to study the topography of the oceans. (NASA Release 94-132)

August 11: NASA announced the appointment of Earle K. Huckins III as Cassini Program Director in the Office of Space Science. An international program, Cassini was designed to explore the planet Saturn, its rings and moons, and the surrounding environment. Scheduled for launch on a Titan IV Centaur in October 1997, the Cassini spacecraft was to swing by Venus, the

Earth, and Jupiter before being inserted into orbit around Saturn in June 2004. Cassini was projected to orbit Saturn for four years. (NASA Media Advisory Aug 11/94)

- An article criticized of the ways in which NASA spent more than half the funds allocated to it on unproductive matters that had not advanced the design of the Space Station. The article alleged that at least 24 months of delays resulting from congressional budget-trimming and frequent redesigns cost \$1.6 billion, a “hefty extra layer of management” cost \$1.1 billion; a discarded propulsion and guidance unit cost \$900 million, a failed data management system cost \$500 million, and other redesigns and deletions cost \$600 million. Since the appointment of Daniel S. Goldin as Administrator, many of the problems had been fixed, but if technical glitches and congressional meddling recurred, the program could again be in trouble. (*Bus Wk*, Aug 15/94)

- Scientist John Bradley of MVA Inc. in Norcross, Georgia, said in a report in the journal *Science* that ancient space dust particles, composed of a black glassy substance embedded with metal, that zipped into Earth’s atmosphere might be older than the solar system. Some of these tiny dust grains appeared to be similar to one of the major raw materials of the universe, interstellar dust grains, known as GEMS (glass with embedded metal and sulfides). Scientists collected GEMS, which they believed were left from a passing comet’s wake, from a NASA U-2 airplane several miles above Earth. The GEMS were rare—only one or two were collected per hour of U-2 flight time—but showed signs of exposure to irradiation when studied under a transmission electron microscope. (UP, Aug 11/94)

August 12: NASA announced that its Galileo Spacecraft had begun a six-month process of radioing to Earth data taken during the collisions of Comet Shoemaker-Levy 9 at Jupiter in July. (NASA Release 94-133)

- NASA’s Ames Research Center, Moffett Field, California, announced the award of a contract for information and communications support services for Ames to I-Net, Inc., Bethesda, Maryland. (NASA Release C94-bb (sic); duplicates number on contract announcement of August 3)

- NASA Kennedy Space Center spokesperson Bruce Buckingham said that that NASA had worked out a plan that would allow NASA employees to have the Labor Day weekend off and still would permit the launching of Shuttle Discovery on September 9. (*Fla Today*, Aug 15/94)

August 13: NASA researchers hoped that, among other things, Endeavour’s comparison radar images from its second environmental voyage would enable them to peer through the mists of Rwanda to track the imperiled mountain

gorilla. In the category of experiments, shortly after liftoff, the crew of Endeavour were scheduled to engage in mixing up a batch of special order concrete, which was to be allowed to harden during the 10-day voyage. After the flight, Master Builders Inc. of Cleveland, who had prepared the ingredients, were to test the concrete to determine the critical particle dispersion that ensured hardness for possible future construction on the Moon or elsewhere. An experiment in earthquake forecasting also was planned. Another planned experiment was the dumping of oil and algae byproducts into the North Sea off Denmark to see if Endeavour's radar could detect them. The countdown for the flight began August 15. (AP, Aug 13/94; AP, Aug 15/94; UP, Aug 15/94; Reuters, Aug 15/94; NY Times, Aug 16/94; USA Today, Aug 16/94; AP, Aug 17/94; Reuters, Aug 17/94; NY Times, Aug 18/94; W Times, Aug 18/94; W Post, Aug 18/94; USA Today, Aug 18/94; AP, Aug 18/94; Reuters, Aug 18/94)

August 14: The digital data representing the first direct image of Comet Shoemaker-Levy 9 slamming into Jupiter reached Earth from Galileo. The impact of the explosions was presumed to have created waves in the atmosphere, and these were being sought by the Infrared Telescope Facility that NASA operated atop Mauna Kea mountain in Hawaii. The explosions sent substantial amounts of helium hundreds of miles above the top of Jupiter, which was a surprise and which NASA's Extreme Ultraviolet Explorer satellite detected. (NY Times, Aug 16/94)

- In anticipation of spending cuts when the new fiscal year would begin October 1, NASA had begun to cut civil service and contractor positions at the Kennedy Space Center (KSC) at Cape Canaveral. Although NASA was eliminating four times as many jobs as in the previous two years, KSC contractors were obliged to let 17 workers go for every government job eliminated. These cuts were taking place despite NASA's plan for eight Shuttle launches in the coming year. (O Sen Star, Aug 14/94)

August 16: NASA announced that it had signed an agreement on biomedical research with the National Institutes of Health (NIH). NASA was to use its bioreactor technology to produce three-dimensional tissue cultures for laboratory research. The goal of the agreement was to engineer a human lymph node model for AIDS research and to extend this technology to a broad spectrum of tissues. (NASA Release 94-134; AvWk, Aug 22/94)

August 18: NASA announced that the flight of Space Shuttle Discovery, scheduled for September 1994, would include two firsts: atmospheric research using a laser, the Lidar In-Space Technology Experiment (LITE), and robotic processing of semiconductor materials. The mission would also feature the deployment and retrieval of a free-flying astronomical observer and the first untethered spacewalk by astronauts in more than 10 years. On August 31,

NASA officials indicated there might be a delay in the contemplated September 9 launch because of problems with the craft's propulsion system. (NASA Release 94-135; AP, Aug 31/94; Reuters, Aug 31/94)

- The flight of Space Shuttle Endeavour was aborted 1.9 seconds before liftoff as a result of automatic engine shutdown caused by an overheated fuel pump. In consequence, NASA officials stated that they were moving the launch of Endeavour to the first week of October because of the time it would take to refurbish the craft. (UP, Aug 18/94; AP, Aug 18/94; Reuters, Aug 18/94; *NY Times*, Aug 19/94; *W Post*, Aug 19/94; *W Times*, Aug 19/94; *USA Today*, Aug 19/94; AP, Aug 19/94; *Fla Today*, Aug 19/94; *O Sen Star*, Aug 19/94; *NY Times*, Aug 21/94; *AvWk*, Aug 22/94)

- Japan's new H-II rocket was aborted six seconds before liftoff when its main liquid fuel engine was ignited but the solid fuel booster rockets failed to ignite. Japan's National Space Development Agency said the problem appeared to be in a ground-control computer known as the countdown sequencer rather than in the rocket. On August 28, the H-II rocket was launched again. However, Japan's space agency said on August 31 that it was abandoning efforts to put into orbit an experimental satellite launched by the H-II rocket. (*NY Times*, Aug 19/94; *O Sen Star*, Aug 19/94; Reuters, Aug 28/94; *NY Times*, Aug 29/94; CSM, Sep 1/94)

August 19: NASA announced that recent results from the Haystack Orbital Debris Radar measurements of orbital debris were good news for the International Space Station. The radar, which was operated for NASA by the MIT Lincoln Laboratory, showed that the measured debris at low altitudes (250-400 miles) was below predicted levels. The improvement resulted in part from NASA's Orbital Debris Mitigation Program under which NASA informed other nations of the hazards resulting from third stage rocket explosions, which led Japan, China, and Russia to join NASA in modifying their launch vehicles and satellites. Other reasons were the decreased military space activities of Russia and the U.S. and the decrease in worldwide space launches. (NASA Release 94-136)

- Drucella Andersen, who served as head of public affairs for aeronautics at NASA, moved to the Federal Aviation Administration as Deputy Assistant Administrator for Public Affairs. (*W Post*, Aug 19/94)

August 21: In discussing the training of two U.S. astronauts in Russia, William Saxe, NASA's representative in Moscow, was quoted as saying that when the astronauts arrived in February, they were refused maps or phone books of Star City, their training center, because these were considered top secret. However, the astronauts were not denied entrance to any of the buildings. The astronauts were not to begin training with Russian cosmonauts until the fall. (*NY Times*, Aug 21/94)

- In September, a conference on space debris was scheduled to be held at Kent University's Unit for Space Sciences in Canterbury, England. Experts from space agencies around the world were to attend the three-day conference. Kent University had become a center of expertise in the study of space debris, having mounted experiments on the subject on several spacecraft. (*Times of London*, Aug 21/94)

August 23: NASA announced the creation of the Office of Space Access and Technology at NASA Headquarters in Washington and the selection of John E. Mansfield as the new NASA Associate Administrator for the office. The merger of two previous offices: the Office of Advanced Concepts and Technology and the Office of Space Systems Development gave greater focus to the development of advanced space technologies and future space launch systems. The changes were to take effect September 6. (NASA Release 94-137; *Defense Daily*, Aug 24/94)

August 24: NASA announced its selection of 15 organizations to receive a total of \$20 million to help develop applications and technologies as part of NASA's efforts to provide public use of Earth and space science data over the Internet. The remote sensing database applications would make the information more accessible to a wider audience than in the past. (NASA Release 94-138)

- NASA announced the successful completion of the first and largest of eight mirrors for the Advanced X-ray Astrophysics Facility (AXAF). The mirror was scheduled to be a part of the AXAF telescope which was to be launched in 1998. (NASA Release 94-139)

- NASA announced the discovery in the southern constellation Scorpius of an unusually bright X-ray source by an instrument aboard NASA's Compton Gamma-Ray Observatory. It remained to be determined whether the new source was a black hole, a pulsar, or some new object, according to B. Alan Harmon of NASA's Marshall Space Flight Center, Huntsville, Alabama. (NASA Release 94-140)

- NASA announced the members of the mid-1995 Space Shuttle mission that was scheduled to carry a NASA Tracking and Data Relay Satellite. The satellite was intended to provide for telecommunications needs essential to the success of Space Shuttle and low-Earth orbit spacecraft missions. The Space Shuttle was to be commanded by Terence T. Henricks. (NASA Release 94-141)

- Bryan O'Connor, overseer of Shuttle operations at NASA Headquarters, said that NASA expected to receive shortly a Russian-built Androgynous Peripheral Docking Assembly that would enable Space Shuttle Atlantis to dock with Russia's Mir Space Station. A damaged tube delayed delivery of the docking component. (*Phillips Business Information*, Aug 25/94)

- A report by the NASA Advisory Council Task Force on the Shuttle-Mir Rendezvous and Docking Missions criticized the lack of one person being in charge of the Shuttle-Mir phase one (1995-97) project. Accordingly, NASA was moving to remedy the situation and make the Space Station program structure similar to the existing Space Shuttle program structure. (Phillips Business Information, Aug 25/94)

August 25: NASA announced that astronaut Franklin Chang-Diaz would be payload commander for the Space Shuttle mission scheduled for early 1996 in which the Tethered Satellite System (TSS) would be flown for the second time. Because of the preparation time required for this mission designed to orbit the TSS at the end of a 13-mile-long tether to test techniques for managing aircraft at great distances and to study the electrodynamic effects of moving a conductive tether through the Earth's magnetic field, the selection was made early. (NASA Release 94-142)

- NASA announced that it, a team of U.S. aircraft and engine manufacturers, and the Russian aircraft firm, Tupolev Design Bureau, planned to use a Russian Tu-144 supersonic transport as a flying testbed for conducting flight research on high-speed enabling technologies. Included in the U.S. team were Boeing, McDonnell Douglas, Rockwell International, General Electric, and Pratt & Whitney. (NASA Release 94-143; *Antelope Valley Press*, Sep 1/94)

- NASA's Johnson Space Center (JSC), Houston, announced the selection of Loral Space Information Systems of League City, Texas, to provide support services for JSC's Safety, Reliability, and Quality Assurance Office. (NASA Release C94-cc)

- At Rockwell International's Science Center in Thousand Oaks, California, scientists such as Maribeth Hunt were finding ways to transfer environmentally oriented space science to uses on Earth. For example, Hunt was packaging a spaceship's laser-powered, toxic-gas analyzer into something the size of a duffel bag that earthly health officials could use to catch industrial polluters. (*LA Times*, Aug 25/94)

August 27: An Air Force Titan 4 rocket was launched successfully from Cape Canaveral Air Station and deployed "in the desired orbit." The classified satellite was thought to have an electronic eavesdropping platform capable of tapping into military and civilian communications. (Reuters, Aug 27/94; *W Post*, Aug 28/94)

- At Russia's request, the Federal Aviation Administration was about to launch a sweeping inspection of Russia's airlines and air safety controls. The review resulted from three serious air crashes in Russia during the year and dire warnings of the dangers of Russian air travel. (*W Post*, Aug 27/94)

- Donna Shirley, Director of NASA's newly formed Office of Mars Exploration at the Jet Propulsion Laboratory in Pasadena, California, discussed NASA's plans to send up to 28 orbiters, landers, and rovers to Mars within the next decade. Glenn Cunningham, program manager for NASA's Mars Global Surveyor, was quoted in connection with keeping the program within cost limits and the November 1996 scheduled launch of the Mars Global Surveyor aboard a Delta 2 rocket. (*Fla Today*, Aug 27/94)

August 29: After an unsuccessful attempt to link with the Mir Space Station, an unmanned Progress M-24 Russian cargo craft was scheduled to try again on August 30. A Russian spokesperson said the docking mechanism of the Progress appeared too sensitive for the Mir's vibrations. The attempt of Progress to dock August 30 again was unsuccessful. However, on September 1, a Russian cosmonaut successfully docked the unmanned supply ship. (AP, Aug 29/94; Reuters, Aug 29/94; *C Trib*, Aug 31/94; UP, Sep 2/94; *NY Times*, Sep 3/94; *W Post*, Sep 3/94; *W Times*, Sep 3/94; *P Inq*, Sep 4/94)

- Itar-Tass news agency reported that Russia had launched the Kosmos-2290 military satellite from the Baikonur Cosmodrome in Kazakhstan. (*W Times*, Aug 30/94)

- Robert Schock, deputy associate director of the energy program at the Lawrence Livermore National Laboratory, Livermore, California, said that the same fuel that powered space shuttles could propel fuel-efficient, environmentally friendly cars of the future. The laboratory had a \$1 million grant to analyze hydrogen applications particularly in the transportation field. (UP, Aug 29/94)

- The Paris-based Euroconsult organization assessed world space markets through the year 2004. The European think tank studied U.S., Asian, and European space and communications companies, agencies, and analysts. It concluded that new communication programs would result in a \$95 billion to \$115 billion global market for satellites, ground stations, and launch services during the period and that U.S. industry was increasing its share of that market. (*AvWk*, Aug 29/94)

August 30: Martin Marietta Corporation of Bethesda, Maryland, and Lockheed Corporation of Calabasas, California, reached agreement to merge and create the world's largest space and defense company. The agreement remained to be approved by shareholders and regulators. According to Lockheed chairman Daniel M. Tellep the merger would result in "significant reduction of costs to the government." Biographic data on Norman R. Augustine, chairman and chief executive of Martin Marietta and president-designate of Lockheed Martin Corporation, were included. (*W Post*, Aug 30/94; *CSM*, Sep 1/94; *W Post*, Sep 4/94; *U.S. News and World Report*, Sep 12/94)

August 31: NASA's John C. Stennis Space Center (SSC), Hancock County, Mississippi, announced the award of a contract to Lockheed Space Operations Company, Titusville, Florida, to provide propulsion and technical services at SSC. (NASA Release C94-dd)

- NASA's Johnson Space Center, Houston, announced the award of a contract for logistics services to Pioneer Contract Services, Inc., Houston. (NASA Release C94-ee)

August: An article described in words and photographs the "CAN DO" project of students in Charleston County, South Carolina, which flew on the Space Shuttle Endeavour. The students' scientific package consisted of four cameras and 261 test tubes filled with samples of all kinds, that NASA technicians placed in a Get Away Special (GAS) canister that NASA made available for educational, government, and research use. Students decided, using weather and orbital data, what Earth features to photograph with the CAN DO camera assembly, which they called GEOCAM. The students set up their control center for GEOCAM at the Medical University of South Carolina in Charleston, and using headphones, were able to communicate with each other and with the Johnson Space Center in Houston. The results of the photographs and experiments were integrated into their courses of study. (*National Geographic*, Aug 94)

- NASA's budget situation and the impact of its congressionally mandated budget cutting on contractors were discussed. Spending on the Space Station was cut significantly, but because most of NASA's budget was tied to long-term space projects downsizing trends were slow to affect contractors. A table was given of the 20 major NASA contractors in fiscal year 1993, including the parent company, the subsidiary, the parent's location, and the amount of the contract. NASA was working on reducing the time required to select contractors and improving the internal procurement process. (*Government Executive*, Aug 94)

September

September 1: NASA announced that it had reached agreement with the Boeing Company on the key elements of the prime contract for the International Space Station. The agreement dealt with the scope of work, program schedule, cost ceiling, and fee arrangements as well as establishing contractual terms for the contract to be signed before year's end. (NASA Release 94-144)

September 2: NASA announced the names of the crew for the Space Shuttle mission to rendezvous and dock with the Russian Space Station Mir in October 1995. The mission commander was designated as Kenneth D. Cameron. (NASA Release 94-145)

September 3: Before setting the final date for the launch of Space Shuttle Discovery, NASA engineers were studying the results of tests conducted on Space Shuttle Endeavour's main engine that shut down 1.9 seconds before takeoff, aborting the launch. (AP, Sep 3/94; W Times, Sep 4/94; B Sun, Sep 4/94; W Post, Sep 4/94; Fla Today, Sep 4/94)

September 5: In a wide-ranging interview, NASA Administrator Daniel S. Goldin reviewed his tenure to date and focused on prospects for civil space flight. Goldin proposed that while private industry would use the low orbiting costs offered by a new single-stage-to-orbit vehicle to profit from commercial space applications, governments would cooperate on building a space infrastructure to support robotic and human exploration. He believed that countries could cooperate in space infrastructure while maintaining competition in space ventures such as the development of a launch vehicle. (AvWk, Sep 5/94)

- The projected testing of the SAFER (Simplified Aid for EVA Rescue) device during an Extravehicular Activity (EVA) by the astronauts in the September Discovery flight was discussed at some length. SAFER was developed by engineers at NASA's Johnson Space Center and was designed to stabilize an astronaut, allowing the astronaut to fly back to safety should the astronaut drift too far from a structure during an untethered EVA. The 83-pound SAFER was intended to be attached to the bottom of an astronaut's spacesuit. Other objectives of the Discovery flight were to orbit the Langley Research Center's LITE (Lidar In-space Technology Experiment) payload, a laser-observation of the Earth, and to release and retrieve the Goddard Space Flight Center's SPARTAN 201 solar-wind research satellite. (AvWk, Sep 5/94; H Post, Sep 5/94; H Chron, Sep 6/94)

September 6: The countdown began for the launch of Shuttle Discovery on September 9. (AP, Sep 6/94; UP, Sep 6/94; Reuters, Sep 6/94; W Post, Sep

7/94; *USA Today*, Sep 7/94; AP, Sep 7/94; UP, Sep 7/94; *NY Times*, Sep 9/94; *USA Today*, Sep 9/94; *W Post*, Sep 9/94; *W Times*, Sep 9/94; CSM, Sep 9/94; *Daily Press*, Sep 9/94; *Virginian-Pilot*, Sep 9/94)

September 7: NASA announced that its Magellan probe on September 6 began a unique experiment designed to return data about the upper atmosphere of Venus and the behavior of a spacecraft entering it. This would mark the beginning of Magellan's final activities because it was expected to burn up in the atmosphere of Venus by October 14. (NASA Release 94-147)

September 8: NASA announced that a new on-line system available over the Internet was speeding up NASA's MidRange procurements. MidRange was a simplified procedure for procurements between \$25,000 and \$500,000; companies would have direct access to such procurement information through the Internet. (NASA Release 94-148)

- NASA announced the selection of an ancient flood plain on Mars as the landing site for the 1997 mission of Mars Pathfinder, one of the first in a new generation of small, low-cost aircraft. The Pathfinder was scheduled to arrive at Mars on July 4, 1997. (NASA Release 94-149)

- A feature article, including photographs, described the problems centering around adequate living room in space for astronauts in relation to the design of the Space Station. The main factor limiting space of the 28-by-14.5 foot habitat was the size of the Space Shuttle's cargo bay in which it would ride into orbit. (*NY Times*, Sep 8/94)

- New Mexico's senators, Democrat Jeff Bingaman and Republican Pete Domenici, sent a letter urging NASA to keep two data facilities at the White Sands Space Network Complex northeast of Las Cruces. A \$5 million building planned for NASA data operations remained empty in Las Cruces because NASA had decided to shift activities to West Virginia, according to NASA officials. However, NASA's inspector general said NASA could save \$39 million through fiscal year 2000 and nearly \$97 million thereafter if data operations connected with the Earth Observing System remained at White Sands instead of being moved to Fairmont, West Virginia. According to a September 5 syndicated column by Jack Anderson, Senator Robert Byrd engineered the change in location. (*Las Cruces Sun-News*, Sep 9/94; *Las Cruces Sun-News*, Sep 10/94; *Las Cruces Sun-News*, Sep 12/94; *Times-West Virginian*, Sep 15/94)

September 9: Space Shuttle Discovery was launched, and the six astronauts began a series of experiments. These included testing the first space-based optical "radar" to probe clouds and aerosols in the atmosphere; carrying the first automated factory in which a robot, not an astronaut, did the work; and later in the week testing SAFER, a new self-rescue rocket-powered backpack.

Also being tested was the Shuttle's manipulator arm to measure the effect of Discovery's thruster plumes, which might pose a problem ultimately in docking with the Russian Space Station Mir. The astronauts experienced some difficulties with a high-speed data recorder that would not work and a communications glitch related to the analysis of steering jet exhaust plumes. The astronauts successfully conducted extensive environmental monitoring using the LIDAR space-based radar—in this connection, NASA warned that looking at Discovery through a large telescope might result in eye damage. On September 13, Discovery released the SPARTAN (Shuttle Pointed Autonomous Research Tool for Astronomy) satellite to study the solar wind, the streams of charged particles hurtling from the Sun through the solar system at 1.5 million mph. The SPARTAN was scheduled to be picked up again by Discovery on September 15, but the capture of the satellite would be complicated by the failure of Discovery's radar system, which meant that SPARTAN could not be tracked. Meanwhile, NASA added another day to Discovery's mission to allow more laser-beam and jet-exhaust experiments to be conducted. On September 15, the astronauts recaptured SPARTAN on schedule and the radar operated, facilitating the operation. On September 16, two of the astronauts took spacewalks without a tether, testing SAFER in space for the first time. They took turns during a 6.5 hour outing and were limited to staying within 25 feet of the Shuttle so that they could be retrieved if SAFER failed. Bad weather prevented the Shuttle landing on September 19; it ultimately was diverted to Edwards Air Force Base, California, where it landed September 20. (*H Chron*, Sep 10/94; *USA Today*, Sep 12/94; *H Post*, Sep 12/94; *H Chron*, Sep 12/94; *CSM*, Sep 13/94; *USA Today*, Sep 13/94; *P Inq*, Sep 13/94; *AP*, Sep 13/94; *W Post*, Sep 14/94; *P Inq*, Sep 14/94; *C Trib*, Sep 14/94; *UP*, Sep 14/94; *Reuters*, Sep 14/94; *NY Times*, Sep 15/94; *USA Today*, Sep 15/94; *P Inq*, Sep 15/94; *W Times*, Sep 15/94; *UP*, Sep 15/94; *Reuters*, Sep 15/94; *W Post*, Sep 16/94; *NY Times*, Sep 16/94; *USA Today*, Sep 16/94; *B Sun*, Sep 16/94; *W Times*, Sep 16/94; *CSM*, Sep 16/94; *AP*, Sep 16/94; *UP*, Sep 18/94; *Reuters*, Sep 18/94; *USA Today*, Sep 19/94; *AP*, Sep 19/94; *UP*, Sep 19/94; *Reuters*, Sep 19/94; *W Post*, Sep 20/94; *NY Times*, Sep 20/94; *B Sun*, Sep 20/94; *P Inq*, Sep 20/94; *USA Today*, Sep 20/94; *AP*, Sep 20/94; *Reuters*, Sep 20/94; *LA Times*, Sep 21/94; *W Post*, Sep 21/94; *W Times*, Sep 21/94; *P Inq*, Sep 21/94; *B Sun*, Sep 21/94; *H Post*, Sep 21/94; *AP*, Sep 21/94)

- NASA announced the award of a contract to the industry team of GE Aircraft Engines and United Technologies' Pratt & Whitney for work on the propulsion component technologies for a 21st century High-Speed Civil Transport. (NASA Release 94-150)

September 11: With aid from NASA, the University of Florida Medical School created a microcomputer, more than 14 years in the making, which enabled physicians to communicate via satellite or telephone. The computer held the latest information from 12 medical reference books and more than 1,000 med-

ical journals and was updated quarterly. Both an electronic library and a record-keeping system were provided to doctors. System 2000 was originally designed to help ailing crew members on distant space stations diagnose their own illnesses. NASA's Director of Aerospace Medicine and Occupational Health, Dr. Earl Ferguson, expected the use of telecommunications in health care delivery to "totally revolutionize the way we practice medicine." (*Fla Today*, Sep 11/94)

- NASA was scheduled to conduct a completely computerized conference, beginning September 12 and lasting through September 30, dealing with flight control projects involving an F-15 research aircraft. Some 200 pages of text and graphics were to be presented on a computer network. (*Antelope Valley Daily News*, Sep 11/94)

September 12: NASA announced that its prime contractor for Space Shuttle orbiters, Rockwell Aerospace, on September 11 received the Russian-built docking mechanism, the Androgynous Peripheral Docking Assembly (APDA). This mechanism would enable Space Shuttle Atlantis to join the orbiting Russian Mir Space Station in June 1995. Work was scheduled to begin immediately at Rockwell's Space Systems Division to assemble the APDA with the Rockwell-built docking system hardware. (NASA Release 94-151)

- NASA Administrator Daniel S. Goldin visited the Johnson Space Center in Houston as his first stop on a fall tour of all NASA facilities. In a tough speech to all employees, he said he wanted more innovation and less bureaucracy. He stressed that in a time of tight government budgets, "every single person is going to have to justify their activity—all the time." In emphasizing the need to improve business practices, he cited the NASA worker-to-manager ratio on some projects as 2-to-1, whereas 12-to-1 was the private sector goal. (*H Post*, Sep 13/94; *H Post*, Sep 14/94)

September 13: Two Russian cosmonauts stepped outside Space Station Mir in order to reposition solar panels outside the Station. They were expected to spend five hours outside, and the repositioning of the panels should facilitate the visit of U.S. Shuttle Atlantis in 1995. (AP, Sep 13/94)

September 14: NASA Associate Administrator for Space Science Wesley T. Huntress announced two new science missions, both aboard small, relatively inexpensive spacecraft. The first, the Transitional Region and Coronal Explorer (TRACE), would observe the Sun to study the connection between its magnetic fields and the heating of the Sun's corona. TRACE, scheduled for launch in 1997, would have Alan Title of the Lockheed Palo Alto Research Laboratory, California, as the Principal Investigator. The second spacecraft, the Wide Field Infrared Explorer (WIRE), scheduled for launch in 1998 to study

the evolution of galaxies, would be headed by Perry B. Hacking of NASA's Jet Propulsion Laboratory, Pasadena, California. The two missions were part of NASA's Small Explorer Program for highly focused science missions. Small Explorer spacecraft weigh approximately 500 pounds, and the missions were expected to cost approximately \$50 million for design, development, and operations through the first 30 days in orbit. (NASA Release 94-152)

September 15: NASA announced that it had begun resurfacing the runway at the Kennedy Space Center, which would improve the wear on Shuttle tires and potentially lead to an expansion of the Return to Launch Site landing crosswind flight rule beyond the present constraint of 15 knots. (NASA Release 94-153)

- An August 17 letter by David Margolis, associate deputy attorney general, confirmed that the FBI's Office of Professional Responsibility was investigating allegations concerning the Justice Department's "investigative and prosecutive functions" in the Houston-based Operation Lightning Strike involving NASA and its contractors. (UP, Sep 15/94; *H Chron*, Sep 15/94; *H Post*, Sep 15/94)

- The Congressional Black Caucus Foundation, Inc. held a legislative conference in Washington, DC, at which NASA had the largest government career recruiting exhibit of any agency. NASA's Associate Administrator for Equal Opportunity Programs, Yvonne B. Freeman, said that NASA was now aggressively recruiting future black scientists as early as elementary school and paying for their training. Of the \$740 million NASA spent on education each year, \$70 million now went to Historically Black Colleges and Universities, up from \$6 million two years previously. Representative Louis Stokes, Democrat from Ohio, who formerly criticized NASA for doing little to hire blacks or enter into contracts with black companies, said NASA Administrator Daniel S. Goldin had really made a difference in NASA's programs. Stokes's appropriations subcommittee was responsible for NASA funding. (*Plain Dealer*, Sep 16/94)

September 16: Scientists said that the first spacecraft to fly over the Sun's south pole—the Ulysses probe, a joint project of the European Space Agency (ESA) and NASA—reached the climax of a 3 billion-kilometer journey through space the week of September 12. As it did so, 80 of the project's 120 scientists met at ESA's research center in the Dutch town of Noordwijk to assess data gained during the four-year space odyssey. Ulysses' chief scientist Richard Marsden believed that the mission would give scientists greater insight into how the solar wind interfered with radio communications and electrical devices on Earth. (Reuters, Sep 16/94)

September 19: NASA announced that high-speed information technologies it had developed could support physicians in remote locations on a new medical

information superhighway by providing them instant access to information and treatment strategies for their patients. The new, integrated computing and telecommunications technologies developed by NASA's Jet Propulsion Laboratory, Pasadena, California, were scheduled to be demonstrated to members of Congress and the Clinton administration on September 20 by the National Information Infrastructure Testbed, a non-profit consortium of corporations, universities, and government agencies. (NASA Release 94-156)

- The matter of space science research—its cost and its usefulness—was discussed in a feature article. Such research developed more or less as an afterthought, but it had already proved valuable in such ways as making precise measurements of the thickness of clouds and dust to enable automated weather satellites. Assessing the legitimacy of the high costs involved was more difficult, but valuable scientific findings had resulted, such as changing ideas about how different levels of compression at the top and bottom of the lung affected the way the lung functioned and contradicting expectations about how the circulation of blood in the body worked. (*Boston Globe*, Sep 19/94)

September 20: NASA announced that the 12-member panel investigating the failure of the National Oceanic and Atmospheric Administration (NOAA)-13 meteorological satellite in August 1993 had concluded that the probable cause was a short circuit that prevented the solar array current from powering the spacecraft and recharging the batteries. The short circuit probably resulted from a 1.25 inch screw that extended too far below an aluminum plate and penetrated the insulation. The board made recommendations for future NOAA spacecraft; NASA supervised the design and construction of the weather satellites. (NASA Release 94-157; *P Inq*, Sep 21/94; AP, Sep 21/94)

- NASA announced that the International Astronomical Union had approved the name Dactyl for the tiny moon discovered on August 28, 1993, in orbit around the asteroid Ida, by NASA's Galileo mission. Dactyl was the first natural satellite of an asteroid ever discovered and photographed. The name derived from the Dactyli, a group of mythological beings who lived on Mount Ida, where the infant Zeus was hidden. (NASA Release, Sep 20/94; Reuters, Sep 20/94; *H Post*, Sep 21/94)

- NASA announced the selection of General Sciences Corporation, Laurel, Maryland, for a contract to provide support services for two Moderate Resolution Imaging Spectroradiometer science support teams, which were key instruments for NASA's Earth Observing System. (NASA Release C94-ff)

September 21: NASA announced that it had selected the science team for the first spacecraft designed to rendezvous with an asteroid, the Near Earth Asteroid Rendezvous (NEAR) mission. The NEAR spacecraft was scheduled for launch in February 1996 aboard a Delta 2 rocket and should arrive in orbit

around asteroid 433 Eros in early January 1999. It would survey Eros for a minimum of one year, at altitudes as close as 15 miles. The NEAR Science Payload would consist of six instruments: a multispectral imager system, a near-infrared spectrograph, an X-ray/gamma-ray spectrometer, a magnetometer, a laser altimeter, and the spacecraft's radio, which was used also for gravity measurements. Members of the science team were assigned to each of these instruments. (NASA Release 94-159)

- NASA announced that astronomers using its Hubble Space Telescope had found a new quasar, a mere 600 million light years away in Earth's cosmic backyard, as opposed to other quasars that were billions of light years away. The discovery of a quasar in galaxy Cygnus A would give astronomers their first opportunity for detailed study of a quasar. (NASA Release 94-160)

- A German company set up a joint venture with China, called EurasSpace, to develop state-of-the-art satellites. It expected to launch its first high-capacity data transmission satellite, the Sinosat-1, in 1997 for the People's Bank of China. The satellite would be assembled and tested in China and boosted into orbit by a Chinese Long March rocket. (UP, Sep 21/94)

September 22: Northrop Grumman Corporation announced that it would reduce its workforce by 9,000 people, or nearly 20 percent, by the end of 1995. The reduction resulted from the shrinking U.S. military budget and the merger of the two corporation, Northrop and Grumman, in May 1994. The areas that would be hard hit by the layoffs were California and Long Island. (NY Times, Sep 23/94)

September 24: A former NASA researcher and subcontractor at the Johnson Space Center, Jong-Hun Lee, was ordered deported as a suspected North Korean agent. The action followed a hearing at which he was not allowed to see all the evidence against him. (AP, Sep 24/94)

September 26: NASA prepared to begin the countdown on September 27 for the scheduled September 30 launch of Space Shuttle Endeavour on its environmental mission. The Shuttle was launched on schedule on September 30. (Reuters, Sep 26/94; USA Today, Sep 27/94; AP, Sep 28/94; H Chron, Sep 30/94; USA Today, Sep 30/94; B Sun, Sep 30/94; Fla Today, Sep 30/94; AP, Sep 30/94; Reuters, Sep 30/94; W Post, Oct 1/94)

September 28: NASA announced that more than a decade after affecting climate on a global scale, residual signs of a powerful El Niño were still visible from space. Oceanographers using data from the U.S.-French TOPEX/Poseidon satellite were tracking the remnant wave of the 1982-83 El Niño as it moved across the Northwest Pacific Ocean, where some scientists theorized it might still be affecting weather in the region. TOPEX/Poseidon,

a joint program of NASA and the Centre Nationale d'Etudes Spatiales, the French space agency, used a radar altimeter to precisely measure sea-surface height. The study was part of NASA's Mission to Planet Earth. Launched August 10, 1992, the satellite had completed two years of its three-year prime mission. (NASA Release 94-162; *W Post*, Oct 3/94)

- At a conference at NASA Headquarters in Washington, DC, officials of NASA and of Spacehab Inc., the Arlington, Virginia, company that built and leased the laboratories that fly in the Space Shuttle, described progress made in the more than 80 missions that had included research payloads. Other private and university researchers were encouraged to join in such projects. (*UP*, Sep 28/94)

- Two groups of astronomers, one centered at Indiana University and the other at Harvard University, announced, based on findings from the Hubble Space Telescope, that the universe was billions of years younger than previously estimated. The Indiana group said the universe could be as little as 7 billion years old whereas the Harvard group estimated the age of the universe at between 9 billion and 14 billion years. The Indiana study was published in the September 29 issue of *Nature* and the Harvard study in the current *Astrophysical Journal*. According to Stephen Maran, a senior astronomer at NASA's Goddard Space Center and a spokesperson for the American Astronomical Society, the findings should lead to further research to explain the discrepancy between the oldest stars and the age of the universe. (*LA Times*, Sep 29/94)

September 29: NASA announced that a press conference was being held at NASA Headquarters in Washington, DC, at which four astronomers would discuss the initial findings resulting from the Hubble Space Telescope and spectroscopic data concerning the spectacular July bombardment of Jupiter by comet P/Shoemaker-Levy 9. Two of the astronomers were affiliated with the Space Telescope Science Institute, which was operated by the Association of Universities for Research in Astronomy, Inc., for NASA, under contract with the Goddard Space Flight Center, Greenbelt, Maryland. Among questions to be discussed was the nature of the body that struck Jupiter: whether it was indeed a comet or an asteroid. (NASA Release 94-161; *W Post*, Sep 30/94; *H Chron*, Sep 30/94; *H Post*, Sep 30/94)

- The Hammer Award, developed by Vice President Al Gore as part of the Clinton administration's "reinventing" government, was presented to John Muratore, Chief of the Johnson Space Center's Control Center Systems Division, and his staff. They were honored for their innovative approach to establishing a high-speed, high-data-rate computer system that would enable the new NASA Mission Control Center to control a space shuttle, the Russian Mir Space Station as well as the planned International Space Station.

They developed a strategy linking smaller, less expensive computers within the nearly 200 flight control work stations. (*H Chron*, Sep 30/94)

September 30: NASA announced that two companies had been recognized as minority contractor and subcontractor of the year for their outstanding contributions to the space program. NASA Administrator Daniel S. Goldin named ERC, Inc., Tullahoma, Tennessee, as Minority Contractor of the Year and BST Systems, Inc., Plainfield, Connecticut, as Minority Subcontractor of the Year. (NASA Release 94-163)

- NASA announced assembly sequence refinements that incorporated the latest updates to plans for the International Space Station. The sequence incorporated early provisions for a centrifuge and allowed for the earlier construction of Russia's Solar Power Platform but did not affect existing major milestones. (NASA Release 94-164)
- NASA learned that instead of the anticipated \$225 million cut in its Space Shuttle budget for 1995, Congress had cut an additional \$141 million, for a total Shuttle budget cut of \$366 million. President Clinton had signed the NASA 1995 spending bill, which allocated \$3.18 billion for the Shuttle program out of a total NASA budget of \$14.37 billion. The effects of the cuts on NASA operations remained to be determined. (*Fla Today*, Sep 30/94)
- Jean-Marc Artaud, program director for the Ariane-5 rocket for the French National Space Agency (CNES) in Guiana, discussed the launch that took place of a solid propellant booster that was part of the new generation rocket. The rocket was launched from a European Space Agency (ESA) center in the jungle of French Guyana on the northeast coast of South America in a test aimed at keeping the ESA in the lead in launching heavy satellites into the next century. (Reuters, Sep 30/94)

October

October 1: The media continued to give extensive coverage to the flight of Space Shuttle Endeavour. One of the natural phenomena on which the radar photography concentrated was volcanoes. On October 1, it photographed Russia's Klyuchevsky Volcano on the Kamchatka Peninsula, which had erupted the previous day. Endeavour also scanned Hawaiian volcanoes and dormant Mt. Rainier and the Rwandan volcanoes where endangered gorillas lived. In addition, it sought traces of ancient river tributaries buried by the Sahara, forest fires and thunderstorms in various areas of the globe, and an earthquake that had occurred in Japan. Another goal was to map Earth's appearance in early autumn and note seasonal environmental changes between photographs taken in April and those in October. If the radar could determine small changes on Earth it could eventually be used to predict earthquakes or volcano eruptions. On October 6, German oceanographers dumped 106 gallons of diesel oil and 26 gallons of algae products into the North Sea to determine how well Endeavour's radar could detect oil slicks and differentiate them from algae. Workers on two oil-recovery ships started to clean up the mess as soon as Endeavour passed and expected to finish within two hours. To gather as much data as possible, the astronauts worked in two 12-hour shifts.

- The failure of a Space Shuttle steering jet on October 5 forced NASA to suspend Endeavour's radar survey of Earth. The astronauts had been engaged most recently in hydrology studies of such regions as the rain forests of Brazil, the mountains of California, and the deserts of Australia. By using manual controls when the steering jet failed, the astronauts were able to trace both the oil and the algae. NASA ground personnel put together a computer program to bypass the sensor and restore use of the jets. NASA also added an 11th day to the mission to allow for more radar observations. On October 7, NASA scientist Henry Reichle said that the air pollution monitor on board Endeavour showed an increase in carbon monoxide above South America, southern Africa, across the Atlantic Ocean between the two continents, and north of Australia. On October 10, the astronauts began to stow scientific gear in preparation for a return on October 11. Bad weather in Florida on October 11 forced Endeavour to land at Edwards Air Force Base in California instead. (*W Post*, Oct 1/94; *AP*, Oct 1/94; *LA Times*, Oct 2/94; *UP*, Oct 2/94; *AP*, Oct 3/94; *W Post*, Oct 4/94; *W Times*, Oct 4/94; *USA Today*, Oct 4/94; *AP*, Oct 4/94; *Reuters*, Oct 4/94; *UP*, Oct 4/94; *AP*, Oct 5/94; *Reuters*, Oct 5/96; *UPI*, Oct 5/96; *AP*, Oct 6/94; *UPI*, Oct 6/94; *Reuters*, Oct 6/94; *NY Times*, Oct 7/94; *H Post*, Oct 7/94; *H Chron*, Oct 7/94; *AP*, Oct 7/94; *NY Times*, Oct 8/94; *W Times*, Oct 9/94; *NY Times*, Oct 9/94; *W Times*, Oct 10/94; *NY Times*, Oct 10/94; *W Post*, Oct 10/94; *AvWk*, Oct 10/94; *AP*, Oct 10/94; *UPI*, Oct 10/94; *Reuters*, Oct 10/94; *NY Times*, Oct 11/94; *W Post*, Oct 11/94; *W Times*, Oct 11/94; *AP*, Oct 11/94; *Reuters*, Oct 11/94; *NY Times*, Oct 12/94; *W Post*, Oct 12/94; *W Times*, Oct 12/94; *C Trib*, Oct 12/94; *AP*, Oct 12/94)

October 2: A photograph was featured of the first node of NASA's international laboratory designed as part of the International Space Station. It was being manufactured by Boeing at NASA's Marshall Space Flight Center in Huntsville, Alabama. (*Fla Today*, Oct 2/94)

October 3: One of the results of the data produced by the U.S.-French TOPEX-Poseidon satellite, part of NASA's Mission to Planet Earth, was the mapping of ocean circulation, one of the least understood areas of climate research. Data had shown that the El Niño remnant wave was pushing the current northward off the coast of Japan, raising the temperature of the north-west Pacific. (*W Post*, Oct 3/94)

- An article analyzed the role played by lasers in advancing atmospheric science. Reference was made to the end of the last Space Shuttle flight when NASA was gathering data simultaneously from different altitudes over the same spot on Earth with three laser systems—one on Discovery and two on research aircraft. A fourth, ground-based Lidar (light detection and ranging) at NASA's Langley Research Center in Hampton, Virginia, also gathered data concurrently. This combination should significantly advance technology toward the goal of a permanent, automated Lidar satellite. The article provided scientific details of the flights undertaken and Discovery's operation of Lite, the Lidar In-space Technology Experiment. (*AvWk*, Oct 3/94)

- NASA announced the identification of nine proposals to begin cooperative agreement negotiations in NASA's Aerospace Industry Technology Program (AITP). AITP was established to focus industry's research and development efforts on dual-purpose aerospace technologies that showed potential for strong commercial applications that might also benefit NASA's programs. In addition to NASA funding, each project also would involve 50 percent or more in non-government cost-sharing. (NASA Release 94-165)

October 4: A Russian Soyuz rocket was launched from the Baikonur Cosmodrome in Kazakhstan carrying two Russian cosmonauts and a German physicist. Its destination was the Mir Space Station where the crew would exchange places with existing Mir cosmonauts. The rocket docked with Mir on October 6. On October 12, the Interfax news agency reported that Mir was experiencing power supply problems because of the drain on its power cells from the presence of six astronauts during the change-over period. On October 28, the German astronaut was scheduled to break the record for the longest space flight by a West European. (*UP*, Oct 4/94; *Reuters*, Oct 4/94; *AP*, Oct 6/94; *AFP*, Oct 6/94; *Reuters*, Oct 6/94; *NY Times*, Oct 7/94; *CSM*, Oct 7/94; *AvWk*, Oct 10/94; *AP*, Oct 12/94; *Reuters*, Oct 28/94)

- The New Zealand Antarctic Programme and the National Institute of Water and Atmospheric Research (NIWA) issued a joint statement saying that a hole in

the ozone layer over the Antarctic had reappeared and was wider than in 1993. NIWA scientist Tom Clarkson said that NASA data showed a rectangular-shaped area of very low ozone concentration covering Antarctica, compared with a slightly smaller triangular hole in 1993. In contrast to the NIWA statement, NASA announced on October 6 that a NASA instrument aboard a Russian satellite had detected a hole in the ozone layer over Antarctica with a surface area equal to the size of the North American continent. It added that the ozone hole levels for 1994 were "nearly as large and as deep as the record lows from October 1993," according to preliminary data obtained by scientists at NASA's Goddard Space Flight Center, Greenbelt, Maryland. (Reuters, Oct 4/94; NASA Release 94-167; *USA Today*, Oct 7/94; AP, Oct 7/94; *NY Times*, Oct 8/94)

October 6: NASA's Langley Research Center, Hampton, Virginia, and Ford Motor Company, Dearborn, Michigan, announced they had concluded a two-year cooperative agreement for the transfer of NASA-developed technology to improve the design and engineering of Ford vehicles. This was the first broad technology transfer process between NASA and any automotive manufacturer. (NASA Release 94-166; *H Post*, Oct 7/94; CSM, Oct 13/94)

- As an example of NASA's undertaking to transfer space technology to private industry a surgical instrument was cited. The device was an instrument designed to reduce the time required for surgeons to close sutures during abdominal endoscopic surgery. (*Antelope Valley Press*, Oct 6/94; *Antelope Valley Daily News*, Oct 17/94; *Desert Wings*, Oct 21/94)

October 7: NASA ground controllers were to send final commands to the Magellan space probe on October 7 to send it crashing to its death in the atmosphere of Venus on October 11. The robot had been in a highly successful Venus orbit since 1990 but its solar panels were failing and its gyroscopes worn out. On October 12, NASA announced that Magellan was expected to burn up within two days. NASA's Jet Propulsion Laboratory in Pasadena, California, declared Magellan dead on October 12. However, Magellan lasted long enough to radio back telemetry showing how much rocket power would be required to offset the increasing atmospheric turbulence, which was useful data for future designers seeking to use the atmosphere of Mars for orbit purposes. (*LA Times*, Oct 6/94; AP, Oct 6/94; *USA Today*, Oct 7/94; *C Trib*, Oct 9/94; *W Post*, Oct 10/94; *AvWk*, Oct 10/94; AP, Oct 11/94; Reuters, Oct 11/94; *W Times*, Oct 12/94; *LA Times*, Oct 12/94; CSM, Oct 12/94; NASA Release 94-170; *Fla Today*, Oct 12/94; Reuters, Oct 12/94; *W Post*, Oct 13/94; *NY Times*, Oct 13/94; *SP News*, Oct 17-23/94)

- NASA announced that Russian cosmonauts on Mir had completed the first in a series of U.S. experiments using NASA's Space Acceleration Measurement System (SAMS). SAMS was activated October 4 to collect vibration data in preparation for future chemistry and physics experiments. (NASA Release 94-168)

- A feature article described three women engineers who worked at the Kennedy Space Center and were among the 120 finalists being interviewed by NASA's astronaut selection board for assignment as astronaut candidates. (*Fla Today*, Oct 7/94)

October 8: Space Shuttle Columbia stopped at Huntsville en route to Rockwell International's facility at Palmdale, California, for scheduled maintenance. Thousands of people came to the airport to see the Shuttle. (*Htsvl Tms*, Oct 9/94)

October 11: Boeing Company of Seattle, prime contractor for the International Space Station, submitted a proposal to NASA outlining work that would be performed under a final contract and the cost of each task. NASA was to review the proposal and then begin negotiations. (*SP News*, Oct 17-23/94)

- On the occasion of the 25th anniversary of the first moonlanding mission, the Italian newspaper *La Repubblica* published an interview with NASA Administrator Daniel S. Goldin. In it he complimented Italy for its good space knowhow, saying Italians were magicians in the area of space communication. He also mentioned ways in which Italy was cooperating with NASA such as the Italian astronaut who was to help complete the testing of the tethered satellite system and the Italian Space Agency's work with NASA on the Cassini Space Mission. He pointed out that above all NASA counted on Italy for the construction of logistic pressurization modules and that this construction would give Italian firms a technological capacity that would have an impact on all Italian industries. (*La Repubblica*, Oct 11/94)

October 12: NASA announced the naming of Italian scientist Umberto Guidoni to the Columbia Space Shuttle mission in early 1996. He would be involved with experiments dealing with the Tethered Satellite System, with which he had previous experience. (NASA Release 94-169)

- NASA announced the selection of Boeing Information Services Inc., Vienna, Virginia, to provide Information Resources Management Support at NASA Headquarters. (NASA Release C94-gg; *Federal Computer Week*, Oct 24/94)

- At a press briefing at the Kennedy Space Center, NASA Associate Administrator for Space Flight Jeremiah Pearson said NASA was currently undertaking a review to gauge the Shuttle program's health after budget cut-backs and to identify possible additional savings. The review was scheduled to be completed in early January. Bryan O'Connor, Shuttle program director at NASA Headquarters, said 13 teams at NASA Field Centers across the country were examining jobs, procedures, and requirements to improve effi-

ciency. However, he indicated that much of 1994's \$141 million cut in the Shuttle program's operating budget could be made up with expected reimbursements and reassignment of funds. For example, Congress had suggested that the program use a \$22 million reimbursement from Japan for Shuttle flights to that end. (*Fla Today*, Oct 13/94; *SP News*, Oct 17-23/94; *AvWk*, Oct 17/94; AP, Oct 24/94)

- Bill Townsend, Deputy Associate Administrator for NASA's Mission to Planet Earth, was quoted as saying that with NASA starting the new fiscal year with a smaller budget, the Space Radar Laboratory might have mapped its last mountain range. Diane Evans, the radar's U.S. project scientist, indicated that the world was waiting to see what NASA would do with the Space Radar Laboratory, which to date had mapped only five percent of the Earth's surface, in comparison with the extensive coverage of the topography of Venus. (*O Sen Star*, Oct 12/94)

October 14: More than 700 Space Shuttle support personnel at NASA's Kennedy Space Center had been on strike for 15 weeks in a labor dispute with contractor EG&G Corporation. The International Association of Machinists and Aerospace Workers, the labor union representing the striking workers, said negotiations were deadlocked over an EG&G demand to limit health insurance benefits for its employees. NASA denied charges that safety had been compromised during the three Shuttle flights launched since the strike began July 5. On October 21 negotiators reached a tentative agreement in their meeting at the Federal Mediation and Conciliation Service headquarters in Washington, DC. The contract proposal covered health insurance, wages, and pensions. The contract remained to be approved by three EG&G sub-contractors and then ratified by the striking union members. (*Defense Daily*, Oct 14/94; AP, Oct 21/94)

October 16: The Ohio Environmental Protection Agency (EPA) ordered NASA in 1991 to conduct a sitewide investigation of longstanding environmental problems across its 352-acre complex on the western border of Cleveland Hopkins International Airport. The problems included dumps containing spent rocket fuel and contamination of soil and water by mercury. To date, there was little evidence of progress apart from much discussion of how the eventual cleanup would be done. (*Plain Dealer*, Oct 16/94)

- A critical article broke down the percentages NASA would devote to various programs during the 1995 fiscal year, out of the \$14.4 billion approved by Congress. The following categories were listed: Space Shuttle, 25 percent; NASA bureaucracy, 15 percent; Space Station, 15 percent; Mission to Planet Earth, 9 percent; physics and astronomy, 8 percent; aeronautics, 6 percent; planetary exploration, 5 percent; advanced concepts and technology, 4 percent; mission communications, 3 percent; launch services, 2 percent; life and micrograv-

ity sciences, 2 percent; space communication and telecommunications, 1 percent; new construction, 1 percent; safety office, .5 percent; inspector general, .5 percent. Not included were wind tunnel operations. (*O Sen Star*, Oct 16/94)

- Another article in the same newspaper commended NASA for having learned the secret to getting along with Congress: humility equaled stability. NASA had done its homework prior to submitting its budget request and received almost everything it asked for. The writer gave most of the credit to NASA Administrator Daniel S. Goldin whose mantra of "cheaper, better, faster" had forced NASA staff to wake up to reality. (*O Sen Star*, Oct 16/94)

- An example was given of the way in which NASA-sponsored research in aeronautics, in this case at the Ames-Dryden Flight Research Facility, had practical applications in daily life. The example involved a redesign of big rig trucks, based on Ed Saltzman's research, which made the trucks more fuel efficient. (*Antelope Valley Daily News*, Oct 16/94)

October 17: NASA announced that its Hubble Space Telescope (HST) had provided new insights into how stars might have been formed billions of years ago in the early universe. A preliminary assessment of HST observations indicated that a pair of clusters in the Large Magellanic Cloud instead of containing fewer than 1,000 stars as earlier thought, contained nearly 10,000 stars. If this were true billions of years ago, it would have altered drastically the early history of the universe, according to Nino Panagia of the Space Telescope Science Institute in Baltimore and the European Space Agency. (NASA Release 94-171)

- NASA announced the establishment of a Phase One Program Office at the Johnson Space Center, Houston, to direct upcoming Shuttle flights to the Russian Mir Station. Tommy Holloway was appointed manager of the office. (NASA Release 94-172)

- The International Space Station was entering a decisive six-month period in which governments in the United States, Russia, Japan, Europe, and Canada were poised to sign the final industrial contracts and intergovernmental accords needed to build the facility. Barring unforeseen developments, the European Space Agency would be unable to commit itself to the Space Station before November 1995, when its member governments' ministers were scheduled to convene. Other remaining hurdles were the signing of the prime contract for Station hardware between NASA and the Boeing Company; the conclusion of a smaller contract between the Canadian Space Agency and Spar Aerospace; a final round of negotiations bringing Russia into full Station partnership; and an agreement among the partners on who would contribute what to the Station's upkeep and the apportioning of access to the Station's limited electricity and other resources. (*SP News*, Oct 17-23/94)

- JoBea Way, a radar scientist at NASA's Jet Propulsion Laboratory in Pasadena, California, came up with the idea for KidSat in November 1993 while working with scholarship students in NASA's Space Radar Laboratory program. KidSat was a project to establish a permanent orbiting research payload that only students could operate to broaden their educational horizons. Sally Ride, director of the California Space Institute at the University of California, San Diego, was backing the project, which would enlist help from NASA and other organizations such as the National Science Foundation and private charitable foundations. The aim would be to begin the first KidSat classroom lessons in the 1995-96 school year. (*SP News*, Oct 17-23/94)
- Flight tests of new terminal automation software confirmed that airline traffic could be routed to arrive at a gate within 20 seconds or less of a scheduled time, while enabling fuel-efficient descents initiated at pilots' discretion. According to NASA researchers, when deployed at hub airports, the complete Center-Tracon Automation System (CTAS) would optimize the flow of aircraft and improve air traffic control productivity significantly. Recent evaluations dealt with the Descent Advisor portion of CTAS but other parts of CTAS provided air traffic controllers with the data they needed to ensure efficient and safe operations. The recent flight tests were performed under a joint research and development effort involving the Federal Aviation Administration, NASA's Ames and Langley Research Centers, the National Center for Atmospheric Research, several contractors, and United Airlines. (*AvWk*, Oct 17/94)
- NASA Administrator Daniel S. Goldin was the scheduled keynote speaker for an October 27-28 conference at Auburn University on the past, present, and future of the U.S. space program. (*Htsul Tms*, Oct 17/94)
- NASA was expanding its efforts to make procurement information readily accessible on the Internet. In the procurement reform act signed by President Clinton the previous week, NASA was granted authority to test soliciting bids for mid-range procurement (from \$25,000 to \$500,000 annually) on the Internet. (*AvWk*, Oct 17/94)
- The crew of NASA's November Atlantis Shuttle mission were scheduled to test the feasibility of an unusual rendezvous procedure for the second docking with Russia's Mir Space Station in 1995. They would fly Atlantis on a "plus R bar" (the radius vector from the target's center of mass to the Earth's center) to rendezvous with and retrieve the Crista-Spas atmospheric research satellite on the ninth day of the planned 11-day mission. The new approach would save fuel and not require any braking. Crista-Spas was to be deployed from Atlantis's robot arm within about 20 hours of Atlantis's launch. (*AvWk*, Oct 17/94; *SP News*, Oct 24-30)
- The Clinton administration authorized NASA to be an advocate for satellites in the evolving National Information Infrastructure/Global

Information Infrastructure (NII/GII), the so-called information superhighway. The Administration wanted to ensure that industry—satellite builders and operators and telecommunications users—was intimately involved in formulating satellites' role in the NII/GII. Industry in turn wanted NASA to provide research and development on "pre-competitive technologies." (*AvWk*, Oct 17/94)

- NASA was scheduled to test fly Pratt & Whitney's new high-pressure oxidizer turbopump on only one of Discovery's three main engines in June 1995 before committing itself to the advanced design pump's use on all Space Shuttle engines. The new pump was intended to simplify Shuttle processing and increase the margin of safety. It was designed to fly 10 times before removal or replacement was required, compared with the single-flight ability of the current pump. (*AvWk*, Oct 17/94)
- NASA was consulting researchers in Canada, Europe, and Japan on how best to build on two successful Earth surveys by a Shuttle-borne set of complex, multifrequency radar instruments carried by the Space Radar Laboratory. NASA had asked the National Academy of Sciences to recommend the next step, such as the possibility of a reflight of the Laboratory. But a major objective was by international consultation to determine the potential for combining international efforts into a joint project to orbit a highly capable space radar system, according to William Townsend, NASA Deputy Associate Administrator in charge of the Office for the Mission to Planet Earth. (*AvWk*, Oct 17/94)

October 18: A Federal grand jury indicted Samuel Johnson, president of Nor-Cal Supply Company in San Leandro, California, in connection with the sale of faulty aerospace bolts to commercial airlines and government aviation agencies, including NASA. The charges resulted from a major investigation by the FBI and the Defense Criminal Investigative Service. (*SF Chron*, Oct 19/94)

October 19: NASA announced that November 3 was the launch date for Space Shuttle Atlantis and its six-person crew on an 11-day mission. The launch date was predicated on successful launch of the Wind spacecraft on November 1 aboard a Delta rocket. (NASA Release 94-173; *H Chron*, Oct 20/94; *USA Today*, Oct 28/94)

- NASA announced that it had released the Draft Environmental Impact Statement for the Cassini mission to Saturn, which would be available for public review and comment over a 45-day period. Cassini was a cooperative scientific mission of the U.S. and European space agencies scheduled for launch in October 1997 for a seven-year robotic spacecraft journey to Saturn. (NASA Release 94-174)

- During a meeting in Moscow with U.S. Congressman James Sensenbrenner, Republican from Wisconsin and ranking member of the House space subcommittee, Russian First Vice-Premier Oleg Soskovets said that the International Space Station Project Alpha would benefit Russia from an economic viewpoint. A contract to create an International Space Station had been signed earlier by Russia's M.V. Khrunichev Space Research Center and the U.S. Lockheed Corporation. During Russian President Boris Yeltsin's recent visit to the United States, he gave the project a high appraisal. Soskovets drew the attention of the U.S. congressional delegation to the financial estimates of the project and to the need to invite China to participate. Sensenbrenner said the main problem was to convince the European Union and Canada first of the need for other participants to meet their commitments in financing the project. Russian Space Agency chief Yuri Koptev told Itar-Tass that the United States had already sent 72 NASA specialists to Moscow and assigned more than "\$17,000 million for the elaboration of the project and \$14,000 million for the Station's operation for 10 years." In answer to a media question on October 18, NASA Administrator Daniel S. Goldin said that when he met recently with Chinese officials, the matter of the Space Station never came up. In mid-November, in discussing the possible inclusion of Goldin in a visit to China and Japan by a U.S. science and technology delegation, Richard DalBello, assistant director for aeronautics and space in the White House Office of Science and Technology Policy, said there would be no discussion during the trip of Chinese inclusion in the Space Station. (Itar-Tass, Oct 19/94; *Defense Daily*, Oct 21/94; *SP News*, Nov 21-Dec 4/94)

- The Analytic Sciences Corporation (TASC) signed a three-year cooperative agreement with NASA to make NASA's space and Earth science data available to elementary school students and their teachers over the Internet. TASC was scheduled to work with the staff at Franconia Elementary School in Fairfax County, Virginia, to design and develop software allowing kindergarten through 6th grade students to access NASA's vast remote sensing weather data. Fritz Hasler, manager of the project at NASA's Goddard Space Flight Center, said that the project should not only help students learn about the weather but also improve their knowledge of the information highway. (PR Newswire, Oct 19/94)

October 20: Some of U.S. astronaut Norman Thagard's equipment would not reach Russian Space Station Mir until May even though he himself was scheduled to reach Mir on March 14. The equipment was all to have preceded him but Russia had experienced problems with some of its space cargo flights. The result would be that there would be fewer blood, saliva, and urine samples returned to Earth and some work would be started later because of lack of test equipment. Jim Nise, NASA manager of Mir-Space Shuttle programs at Johnson Space Center, was doing his best to expedite matters and Thagard was philosophical about the situation. In November, NASA

Administrator Daniel S. Goldin told the American Astronautical Society of the delay, indicating there was a problem getting Thagard's gear for experiments through Russian customs. (*H Post*, Oct 20/94; *NY Times*, Nov 29/94; *Birmingham Post-Herald*, Nov 30/94)

- Freelance journalist Alcestis Oberg maintained that following the November elections NASA Administrator Daniel S. Goldin planned to cut jobs at Johnson Space Center drastically. According to the article, Goldin hoped to reduce the Space Shuttle operations workforce by 50 percent in five years. A worst-case scenario involved a cut of 30 percent in 1995. (*H Post*, Oct 20/94)

- NASA announced that it would continue to study how the Earth's environment was changing and how human beings affected that change during the upcoming flight of Space Shuttle Atlantis. This, the third flight of the Atmospheric Laboratory for Applications and Science (ATLAS) was part of NASA's Mission to Planet Earth. Also during the mission astronauts would deploy and retrieve a free-flying satellite designed to study the middle and lower thermospheres and would perform various experiments covering life sciences research and microgravity processing. The flight, commanded by Donald R. McMonagle, was scheduled for launch on November 3. (NASA Release 94-175)

- The Department of Energy (DOE) unveiled "a revolutionary 21st century" lighting system that used a bulb of sulfur bombarded by microwaves to produce bright illumination resembling sunlight—and did so at a fraction of the cost of many conventional systems. The prototype lamp was invented by a Rockville, Maryland, start-up company called Fusion Lighting Inc. and developed under contract to DOE. NASA had a two-year contract with the company to develop lights for growing plants in space. (*W Post*, Oct 21/94)

- NASA Administrator Daniel S. Goldin presented Congressman Louis Stokes with the National Association of Small Disadvantaged Businesses Meritorious Award "for his outstanding contributions in the performance of contracts at the NASA Lewis Research Center and turning NASA Lewis Research Center around." (*Call and Post*, Oct 20/94)

- In a speech to aerospace executives at the South Bay Association of Chambers of Commerce, NASA Administrator Daniel S. Goldin stated that "survival of the fittest," the new motto at NASA's contract office, should also be the rule at aerospace companies. He asserted that defense and space companies must follow NASA's lead in streamlining operations and delivering results for the public. (*Daily Breeze*, Oct 21/94)

October 21: The publication of former astronaut Jim Lovell's new book, *Lost Moon: The Perilous Voyage of Apollo 13*, led to an article recounting the Apollo

13 flight 24 years previously. He stated his belief that NASA Administrator Daniel S. Goldin should do more to use NASA's past successes to show how NASA had progressed since. (*W Times*, Oct 21/94)

- NASA announced that it had selected 412 small business research proposals for immediate negotiation of Phase I contracts up to \$70,000 to perform a six-month feasibility study under its 1994 Small Business Innovation Research Program. Successful completion of Phase I would make companies eligible to compete in 1995 for two-year contracts in the amount of \$600,000. (NASA Release 94-176; *Huntsville News*, Oct 26/94)

October 22: An article described awards of the National Science Foundation (NSF) to Historically Black Colleges and Universities and institutions serving Latinos and Native Americans. Specific reference was made to Clark Atlanta University in Georgia, which had built a multimillion-dollar science research facility, doubled its science faculty, increased the number of students in science and mathematics, and attracted large federal grants, including funds from NASA. As a result of its efforts, Clark Atlanta was now a finalist for one of six \$25 million NSF grants. (*C Trib*, Oct 22/94)

- NASA Administrator Daniel S. Goldin and astronaut James D. Halsell gave a talk at California State University, Los Angeles (CSLA). Both men stressed the importance of education and discussed NASA's forthcoming projects. The talk ended with congratulations to CSLA electrical engineering professor Helen Boussalis, who won a \$3.8 million grant for her project to design and build a model space segmented telescope. (*University Times*, Oct 27/94)

- Although the November 3 mission of Space Shuttle Atlantis would be devoted primarily to the study of Earth's ozone layer, it would also entail a study of mammalian development in space, based on research on ten pregnant laboratory rats and their twin offsprings. The countdown for the launch was to begin on October 31. (*Fla Today*, Oct 22/94; AP, Oct 31/94; Tass, Nov 1/94)

October 23: The research of engineers at NASA's Langley Research Center, Hampton, Virginia, was featured, together with its applications to industry. Specifically, pistons were discussed and the benefits of making them from carbon instead of aluminum. NASA had "working agreements" with Ford, General Motors, lawn mower engine maker Briggs & Stratton Inc., and engine maker K&B Manufacturing Company, that would allow them to use Langley piston technology if they should decide to make the pistons. (*Daily Press*, Oct 23/94)

- NASA was among the agencies making presentations at the briefing on women's health sponsored by the Public Health Service and the

Congressional Caucus on Women's Issues. Public Health Service officials predicted that high-contrast digital detectors would be capable in the next one or two years of finding breast cancers at early stages when they were still too small to be detected by today's radiology equipment. NASA and the National Cancer Institute were funding research that should produce the new detectors. (*W Times*, Oct 23/94)

October 24: NASA was pressuring the European Space Agency (ESA) to allow U.S. personnel greater access to European industry, laboratories, and reviews in order to provide additional assurance that the U.S./European Cassini mission to Saturn would succeed. The mission was of great importance to NASA and it felt that ESA's contribution to Cassini was not being coordinated fully with NASA. The pressure was creating sharp controversy among Europeans who did not want such extensive U.S. access although NASA proposals included greater European access to U.S. facilities. NASA managers raised the issue with their European counterparts behind the scenes at the International Astronautical Federation conference taking place in Jerusalem. NASA pressure resulted from NASA Administrator Daniel S. Goldin's instruction to NASA Cassini managers that they must assume responsibility for quality control not just for the orbiter but the whole mission, including the Martin Marietta Titan-4 booster and the ESA probe. (*AvWk*, Oct 24/94)

- The Federal Aviation Administration (FAA) was pushing ahead with certification of predictive wind shear systems. Robert Passman, FAA associate program manager for airborne wind shear research, said he believed airborne predictive systems worked, based on observing one on a NASA aircraft in Orlando, Florida, in 1993. He noted that the alarms from such a system correlated well with ground-based Terminal Doppler Weather Radar detection of microbursts. (*AvWk*, Oct 24/94)
- NASA announced that its geologists were using radar images and photographs taken during Endeavour's recent Space Shuttle mission to study possible new lava flows from Mount Klyuchevsky on Russia's Kamchatka peninsula. The daily Shuttle tracking of the eruption provided the most detailed documentation of such an eruption ever obtained from orbit. (NASA Release 94-179)
- The U.S. Energy Department decided to stop funding work on plutonium powered Radioisotope Thermoelectric Generators (RTGs) after 1966. The decision caused concern among scientists and engineers at NASA and the Energy and Defense departments that America's space nuclear power programs might be ended, making it more difficult to conduct missions to the outer planets such as the planned Pluto Fast Flyby. To date the Energy Department and its contractors had designed, built, fueled, and tested every RTG earmarked for NASA and Defense Department spacecraft. RTGs, which converted heat from decaying plutonium into electricity, were considered

essential for missions to the most distant planets in the solar system where solar panels were unable to produce enough power. (*SP News*, Oct 24-30/94)

- The previous week NASA had released documents laying the ground rules for what was certain to be a heated competition among U.S. aerospace contractors. Final documents were scheduled to be released in mid-November. NASA's need was for a revolutionary rocket to replace the Space Shuttle, a Reusable Launch Vehicle (RLV). It was to be a cooperative project between NASA and industry, with industry participating in the funding of the RLV. The goal was an operational single-stage-to-orbit rocket that would replace the Space Shuttle in 2010 or 2012. (*SP News*, Oct 24-30/94)

- Anser Inc., a public service research institute, announced the appointment of Richard Kohrs, formerly director of Space Station Freedom at NASA Headquarters in Washington, DC, as manager, aerospace business development. Kohrs served more than 30 years with NASA in various capacities. (*PR Newswire*, Oct 24/94)

- NASA created or saved an estimated 5,300 direct and indirect jobs in the U.S. economy in the preceding 18 months because of technology transfer programs at Marshall Space Flight Center (MSFC). Of these, some 1,170 were in Alabama, according to Harry Craft Jr., manager of the MSFC Technology Transfer Office, 1,078 in Pennsylvania, and 430 in Tennessee. Most of the companies helped were small businesses. (*Htsvl Tms*, Oct 24/94)

October 25: Observations from Space Shuttles and other vehicles revealed a clearly visible line stretching for hundreds of miles across the Pacific Ocean. The dark green line, from one to several miles wide, was attributed by scientists to an abundance of microscopic plants that thrived where cold, nutrient-rich water from polar seas met warm equatorial currents. New observations of the interaction between these two currents were made from the NOAA-11 weather satellite and NASA's P-3 research aircraft flying 500 feet above the water. (*NY Times*, Oct 25/94; *AP*, Oct 31/94)

- An obituary of Myron S. Malkin described him as the physicist who was the first director of the Space Shuttle program from 1973 to 1980. He served as a consultant to NASA and was in the control room for the Shuttle's first flight in April 1981. (*AP*, Oct 25/94; *NY Times*, Oct 26/94)

- NASA was scheduled to open a new facility, the Global Hydrology and Climate Center, in Cummings Research Park West in Huntsville, Alabama, October 27. The focus of the Center's \$15 million annual program was to study Earth's water cycle and the ways in which it affected climate. Research would involve collection and analysis of rainfall, lightning, and temperature data on a global scale, according to Center director Ron Greenwood. The

Center was to house 42 scientists from Marshall Space Flight Center, 59 from the University Space Research Association, and 46 faculty, staff, and students from the University of Alabama in Huntsville. NASA Administrator Daniel S. Goldin was present to open the Center, which was to operate in cooperation with the other institutions mentioned and to concentrate on studying water vapor. (*Htsvl Tms*, Oct 25/94; *Htsvl Tms*, Oct 27/94)

- In a press release, Jim Waterman, Boeing Space Station manufacturing manager, said that Boeing had built 18,700 pounds of hardware to date for the International Space Station and was on schedule to complete almost 50,000 pounds of hardware within the next year. Using the manufacturing facility at Marshall Space Flight Center originally built for fabricating Saturn rocket stages, it had made a good start on three pressurized modules for the Station as well as hatches and experiment racks. (*Aerospace Daily*, Oct 26/94)

- Victor Blagov, deputy head of Russian space missions, said that the six cosmonauts on the aging Mir Space Station would have to ration electricity for several months after the craft's solar batteries were unexpectedly drained. Problems first appeared on October 11 after a powerful piece of electrical equipment suddenly sprang to life, shutting down part of the Station and running down four of the six batteries. Four other solar batteries could not be put aboard Mir until the middle of 1995. (Reuters, Oct 25/94)

October 26: An article criticized NASA for abandoning its big space plans and instead engaging in some rather abstruse scientific studies as a result of its Mission to Planet Earth. (*W Post*, Oct 26/94)

- NASA announced that astronomers using its Hubble Space Telescope had taken an important step toward determining the age and size of the universe. They had been able to calculate with considerable precision the distance to a remote galaxy, M100, in the Virgo cluster of galaxies. This measurement established the distance to the cluster as 56 million light-years (with an uncertainty of +/- 6 million light-years). The research results, which were to be further refined, were being published in the October 27 issue of *Nature*. The overall conclusion was that the universe was only 8 to 12 billion years old. (NASA Release 94-180; Reuters, Oct 26/94; *NY Times*, Oct 27/94; *W Post*, Oct 27/94; *USA Today*, Oct 27/94; *W Times*, Oct 27/94; *H Post*, Oct 27/94; *C Trib*, Oct 27/94; *Bakersfield Californian*, Oct 27/94; *CSM*, Oct 28/94; *W Times*, Oct 29/94; *Time*, Nov 7/94; *U.S. News and World Report*, Nov 7/94)

- Wilbur Trafton, NASA's Space Station program director, who was in Houston to attend the Space Exploration 94 conference sponsored by the NASA Alumni League, said several Chinese officials attending a gathering of aerospace professionals in Huntsville, Alabama, asked informally about joining the U.S.-led International Space Station program. They were urged to

pursue their goal through diplomatic channels. (*H Chron*, Oct 27/94; *H Post*, Oct 27/94; *W Times*, Oct 27/94)

- NASA Administrator Daniel S. Goldin visited Huntsville and the Marshall Space Flight Center but declined to endorse Representative Bud Cramer, Democrat, saying it was not appropriate for him to get into partisan politics. Goldin did, however, give Cramer credit for his help in saving the Space Station and he announced that a new generation launch vehicle would be developed at Marshall. (*Huntsville News*, Oct 28/94)

- Senator Howell Heflin, Democrat from Alabama, told a space conference at Auburn University that he owed his life to the space program. He referred to angioplasty, a pacemaker, and a steel artery expansion device, all of which were based on space-related research. NASA Administrator Daniel S. Goldin and several Auburn graduate astronauts also took part in the program. (*Htsvl Tms*, Oct 28/94)

- In a speech to the Huntsville-Madison County Chamber of Commerce, NASA Administrator Daniel S. Goldin said that the Marshall Space Flight Center's top priority was safe Space Shuttle propulsion. The second priority was the Center's share in the Space Station program and the third priority was the Advanced X-ray Astrophysics Facility, and X-ray telescope scheduled to be launched in the late 1990s. (*Htsvl Tms*, Oct 28/94)

October 28: NASA scientist David R. Proctor, a defendant in the NASA sting operation, wrote a letter to Attorney General Janet Reno on October 8, giving details of his 1993 encounter with FBI agents and his nine weeks as their informant. Proctor claimed he had been accused of crimes he did not commit and asked that his indictment be halted while Reno examined his complaint. (*H Post*, Oct 28/94)

- NASA announced the creation of an Office of Policy and Plans at NASA Headquarters, with Alan Ladwig as Associate Administrator. Previously, Ladwig had been a senior space policy analyst in private industry. (NASA Release 94-181)

October 30: Prior to each Shuttle launch, NASA was obliged to remove the alligators that nested in the ditches along the causeway leading to the launch site. NASA had requested permission to fill in the ditches in order to solve the problem. (*O Sen Star*, Oct 30/94)

- NASA's Kennedy Space Center obtained an Andros robot to increase the safety of its workforce and save time and money. The robot could perform such tasks as deflating Space Shuttle tires and checking for bombs, which would be dangerous for humans. (*Fla Today*, Oct 30/94)

- NASA's Wind spacecraft, built by Martin Marietta Astro Space in East Windsor, New Jersey, was scheduled to be launched November 1 or 2, weather permitting. The spacecraft was to study the solar wind, its origin, three-dimensional features, and interaction with the Earth over a two-to-three-year period. Specifically, the principal goal of the mission was to measure the mass, momentum, and energy of the solar wind that somehow was transferred into the space environment around the Earth. The spacecraft was launched successfully November 1. (*Star-Ledger*, Oct 30/94; *Goldsboro News-Argus*, Nov 1/94; *NY Times*, Nov 2/94; *W Post*, Nov 2/94; *CSM*, Nov 2/94; *H Chron*, Nov 2/94; *USA Today*, Nov 2/94)

- A retrospective article looked at the role that NASA's Dryden Flight Research Center at Edwards Air Force Base in California had played in the past, beginning with its establishment in 1947. It asserted that although now Dryden was used only for Space Shuttle landings when bad weather prevented the Shuttle from landing in Florida, it still managed to keep some 1,000 government and civilian employees busy. (*Antelope Valley Press*, Oct 30/94)

October 31: NASA's Kennedy Space Center, Florida, announced the award of a contract to Rockwell International Corporation, Downey, California, to continue providing Shuttle Orbiter logistics operations requirements. (NASA Release C94-hh)

- The work of NASA's Ames Technology Commercialization Center in Sunnyvale, California, was commended in an article. Since its establishment, the year-old Center had created 13 companies that were waiting for financing from joint venture companies or private sources for projects relating to space work. (*San Jose Business Journal*, Oct 31/94)

October: A lengthy article under the heading: "NASA's Research and Development Enhances Life on Earth," described NASA's ongoing environmental research. Among the specific programs covered, together with the functions of each, were: the Upper Atmosphere Research Satellite, the U.S.-French TOPEX-Poseidon Oceanographic Spacecraft, Weather Satellites, Geostationary Satellites, Polar-Orbiting Satellites, the Advanced Microwave Sounding Unit, the Total Ozone Mapping Spectrometer, the Atmospheric Laboratory for Applications and Science, the Stratospheric Aerosol and Gas Experiment, and the Lidar (Light Detection and Ranging) In-Space Technology Experiment. (*Bay Runner*, Oct 94)

November

November 1: NASA announced the appointment of astronaut Ronald M. Sega as Director of Operations, in charge of NASA operational activities at Star City, Russia, near Moscow. His assignment was to support training and preparations of NASA astronauts at Gagarin Cosmonaut Training Center, Star City. (NASA Release 94-182)

- Kenneth Iliff, NASA Dryden Flight Research Center's first chief scientist, was featured. He developed a mathematical methodology used by nearly all the free world's flight test organizations to study flight dynamics, performance, and aerothermodynamics. (*Antelope Valley Press*, Nov 1/94)

November 2: NASA announced that the Geostationary Operational Environmental Satellite (GOES)-8 had successfully completed basic engineering testing and was beginning to provide more precise data for improved weather forecasting. The older GOES-7 was to be shifted further west to cover storms approaching from the Pacific. (NASA Release N94-77; *W Post*, Nov 8/94; *W Times*, Nov 9/94)

- In order to carry out a complex docking experiment that involved detaching the Soyuz spacecraft from Mir and then redocking using automatic systems, the three cosmonauts aboard the Russian Space Station would remain in space an additional day. The operation was carried out successfully on November 2. On November 4, the German scientist and two cosmonauts returned to Earth. (Reuters, Nov 2/94; *Phoenix Gazette*, Nov 4/94; AP, Nov 4/94; UP, Nov 4/94)

- NASA's Hubble Space Telescope took new images of the planet Uranus that revealed the planet's rings, at least five of the inner moons, and bright clouds and a high altitude haze above the planet's south pole. (NASA Release N94-78)

November 3: Space Shuttle Atlantis was launched and after reaching a 184-mile high orbit, the astronauts activated the Atmospheric Laboratory for Applications and Science and began collecting data concerning the depletion of Earth's protective ozone layer. Jacques Cousteau was on hand to watch the launch, at the invitation of several astronauts. French astronaut Jean-Francois Clervoy planned to launch a German satellite November 4 to study the ozone layer and the effects of solar radiation. A new approach was to be used to retrieve the satellite, comparable to a procedure to be used ultimately in docking with Mir. On November 5, it was reported that a German ozone monitor was not operating despite efforts to cool it and then rewarm it. Other instruments aboard, however, were able to monitor the ozone. At one point on November 6, the Shuttle briefly lost contact with NASA's control center

because of crossed radio signals. The astronauts also studied the seasonal hole in the ozone layer over Antarctica. On November 9, for the third time, Atlantis astronauts aimed solar-energy monitors at the Sun seeking clues about the dwindling ozone layer and global warming. A German satellite released from Atlantis the previous week had produced a first-of-its-kind global map of oxygen particles that scientists believed help cool the Earth. On November 10, scientists in Germany and Russia as well as those in the United States launched ozone-mapping balloons and rockets as Atlantis and its satellite passed overhead. NASA had launched 18 weather balloons and 20 small rockets from Wallops Island, Virginia, thus far in an experiment to verify the spacecraft's data. The astronauts successfully retrieved the German ozone-measuring satellite on November 12. Bad weather at the Kennedy Space Center, Florida caused NASA managers to divert Atlantis's landing on November 14 to Edwards Air Force Base, California. (Reuters, Nov 3/94; *W Post*, Nov 4/94; *NY Times*, Nov 4/94; *USA Today*, Nov 4/94; *W Times*, Nov 4/94; *H Chron*, Nov 4/94; AP, Nov 4/94; *Fla Today*, Nov 4/94; UPI, Nov 4/94; Reuters, Nov 4/94; *W Post*, Nov 5/94; Reuters, Nov 5/94; *LA Times*, Nov 6/94; *W Post*, Nov 6/94; *NY Times*, Nov 6/94; AFP, Nov 6/94; UP, Nov 6/94; Reuters, Nov 6/94; *USA Today*, Nov 7/94; *W Times*, Nov 7/94; *W Post*, Nov 7/94; *C Trib*, Nov 7/94; *AvWk*, Nov 7/94; *NY Times*, Nov 8/94; *W Post*, Nov 8/94; *W Times*, Nov 8/94; AP, Nov 8/94; *NY Times*, Nov 9/94; *W Post*, Nov 9/94; *USA Today*, Nov 9/94; AP, Nov 9/94; *NY Times*, Nov 10/94; *W Post*, Nov 10/94; *USA Today*, Nov 10/94; *Daily Gleaner*, Nov 10/94; AP, Nov 10/94; *W Times*, Nov 11/94; *NY Times*, Nov 12/94; *Salt Lake Tribune*, Nov 12/94; *H Chron*, Nov 12/94; AP, Nov 12/94; Reuters, Nov 12/94; *W Post*, Nov 13/94; *NY Times*, Nov 13/94; *W Times*, Nov 13/94; *W Times*, Nov 14/94; Reuters, Nov 14/94; AP, Nov 14/94; UP, Nov 14/94; Reuters, Nov 14/94; *LA Times*, Nov 15/94; *NY Times*, Nov 15/94; *W Post*, Nov 15/94; AP, Nov 15/94)

- Jeffrey E. Carr, a spokesperson at NASA's Johnson Space Center, confirmed that NASA had ordered a safety investigation of a medical experiment scheduled for spaceflight in 1995 after an astronaut collapsed and required emergency treatment during a test of a chemical used in the research. It was later revealed that the incident occurred to Bonnie J. Dunbar, while in Houston for training in October; a review board was to examine the incident. (AP, Nov 3/94; *H Post*, Nov 4/94; *AvWk*, Nov 7/94)
- NASA announced that astronauts John E. Blaha and Shannon W. Lucid had been selected to train for the second of at least four scheduled astronaut stays aboard Russian Space Station Mir. The two were to begin training in Star City, Russia, in February 1995. (NASA Release 94-183)
- NASA announced that the fifth annual technology conference and exposition, Technology 2004, would be held November 8-10 at the Washington Convention Center, Washington, DC. (NASA Release 94-184)

November 6: The joint Air Force-NASA space plane program, which involved NASA's Langley Research Center in Hampton, Virginia, ended September 30. It was replaced by a program that focused on the plane's engine rather than the entire plane. Engineers at Langley had conducted space plane engine research for 35 years under the Hypersonic Systems Technology Program and were attempting to solve the most challenging problem: how to propel the space plane into space. Currently, they were testing a scramjet (supersonic combustion ramjet). In addition to Langley, engineers were working on the space plane at NASA centers in Ohio, California, and Mississippi, and at Wright-Patterson Air Force Base in Ohio. (*Daily Press*, Nov 6/94)

November 7: An article about technology transfer, in discussing progress made in this regard, mentioned that NASA had ordered that technology transfer be an integral part of every employee's job. It also indicated that NASA's Small Business Technology Transfer awards were judged as "balanced and fair." (*AvWk*, Nov 7/94)

- NASA, together with the U.S. Department of Energy, the U.S. Department of Defense Information Systems Agency, AT&T, and Foxworth & Dinkins, a Washington, DC-based marketing firm, sponsored a three-day conference at Clark Atlanta University November 7-9 that brought representatives of the 117 Historically Black Colleges and Universities to explore the opportunities for minority students in science and mathematics. NASA Administrator Daniel S. Goldin was one of the conference speakers. (*Atlanta Business Chronicle*, Nov 11-17/94)

- NASA was scheduled to deliver in late October for the Clinton administration review a comprehensive plan for the United States to develop a reusable launch vehicle (RLV). Proposals were contemplated that would be funded by business with NASA providing the needed technologies, for two RLVs: the X-34 for small payloads and the X-33 single-stage-to-orbit that could lead to a replacement of the Shuttle. The goal was, eventually, to replace expendable launch vehicles (ELVs). With a declining budget NASA's future depended on cheap space transportation and thus far there was little evidence that such RLVs were likely in the near future. In late November it was reported that Boeing Company and McDonnell Douglas Corporation would announce on November 29 that they were joining to compete for initial contracts to build a next-generation Space Shuttle based on reusable rockets. McDonnell Douglas had led in the development of single-stage-to-orbit launch systems and Boeing was a major integrator of complex programs. (*AvWk*, Nov 7/94; *WSJ*, Nov 29/94; *Reuters*, Nov 29/94; *AP*, Nov 29/94; *LA Times*, Nov 30/94; *USA Today*, Nov 30/94; *H Post*, Nov 30/94; *Antelope Valley Press*, Dec 1/94; *SP News*, Dec 5-11/94; *CSM*, Dec 6/94)

- NASA was evaluating 28 proposals for innovative, low-cost planetary science missions and was expected to make selections by late January 1995. (*AvWk*, Nov 7/94)

- NASA's Marshall Space Flight Center and a consortium led by Texas Instruments' Metallurgical Materials Division were trying to use advanced aerospace materials to develop a demonstrator automobile engine significantly lighter and more efficient than the ones in present use. They planned to use high-temperature, high-strength materials developed for the defunct National AeroSpace Plane. NASA would provide funding under its Aerospace Industry Technology Program. (*AvWk*, Nov 7/94)
- Seven European nations—Britain, France, Germany, Italy, the Netherlands, Spain, and Sweden—planned to combine their aeronautics agencies to create the Association of European Research Establishments (AEREA). The goal would be to streamline development, eliminate duplication, improve efficiency, and lay the groundwork for a unified European technology base. The seven agencies had a combined workforce of 19,930, including 8,695 scientists, engineers, and technicians. AEREA was designed in part to counter a "U.S. technology threat." (*AvWk*, Nov 7/94)
- The European Transonic Windtunnel (ETW), which was about to open, posed a challenge to the United States and to NASA. The project was funded by Britain, France, Germany, and the Netherlands and was one of the most advanced aeronautical research facilities in the world. U.S. officials had used the ETW as an example of why NASA should build at least two new tunnels to help U.S. companies compete with European rivals. ETW officials said the new tunnel was already booked through mid-1996. (*AvWk*, Nov 7/94)
- The Wide Field Infrared Explorer (WIRE) spacecraft was designed to use recent advances in large format infrared technology to answer some key questions concerning the formation of stars. The project—the fifth in a series of NASA Small Explorer program missions—was being designed to observe starburst galaxies about 500 times fainter than those recorded at 25 microns by the Infrared Astronomical Satellite in 1983. NASA's Jet Propulsion Laboratory worked with the Space Dynamics Laboratory at Utah State University to build the cryogenically cooled infrared telescope. The three-axis spacecraft, which would be provided by NASA's Goddard Space Flight Center—would be the same design Goddard developed for the Submillimeter Wave Astronomy Satellite, a Small Explorer mission planned for 1995. The WIRE spacecraft was to be launched on an Orbital Sciences Corporation Pegasus XL, which was scheduled to be air-dropped from an L-1011 carrier aircraft. (*AvWk*, Nov 7/94)

November 8: Using the Hubble Space Telescope, astronomers mapped the previously unseen face of Titan, Saturn's largest Moon, and discovered a surface feature that was the size of Australia. Peter Smith of the University of Arizona presented the findings of his team at the annual meeting of the Division of Planetary Sciences of the American Astronomical Society. (*NY Times*, Nov 8/94; *O Sen Star*, Nov 27/94)

- NASA announced the appointments of astronauts Kevin P. Chilton and William F. Readdy to command the third and fourth Space Shuttle/Mir docking missions respectively. The missions were scheduled for March and July 1996. (NASA Release 94-185)

November 9: NASA announced that aerospace industry engineers were finding NASA's Remote Access Wind Tunnel (RAWT) at the Ames Research Center, Moffett Field, California, was saving them time and money in testing a model of a next-generation supersonic transport. The RAWT was equipped with a computer and video camera that allowed them to send real-time test data to engineers at aerospace companies nationwide. (NASA Release 94-186)

November 10: NASA announced that the Ulysses spacecraft, the first probe to explore the Sun's environment at high altitudes, had completed a pass on November 5 over the southern solar pole, ending the first phase of its primary mission. Members of NASA's Jet Propulsion Laboratory, Pasadena, California, reported the development including the fact that Ulysses found a uniform magnetic field at the Sun rather than any magnetic poles. In the Sun's polar regions, the solar wind was found to be flowing at a very high velocity of about 750 kilometers per second, nearly double the speed of the solar wind at lower latitudes. (NASA Release 94-187; *LA Times*, Dec 4/94; UPI, Dec 5/94)

November 11: Following what NASA Administrator Daniel S. Goldin described as two successful days of talks with Russian Space Agency officials about the International Space Station, Goldin said the Station was still on track despite problems with Russia's Mir orbital laboratory. Goldin said the United States was paying Russia more than \$300 million to place its astronauts aboard Mir over the next two years. The Russian segment of the Station was to be run by the mission control center in Kaliningrad near Moscow. Joint training was already being conducted at the Russian and American control centers. The Russian newspaper *Krasnaya Zvezda* said that the United States put the cost of the Space Station at \$20 billion and added that it was not known what the cost would be to Russia or how the cost would be funded. The current situation in Russia was particularly difficult and Russia would need to rely on its own efforts and could not count on funds from abroad. (Itar-Tass, Nov 11/94; *Moscow Tribune*, Nov 12/94; *Izvestiya*, Nov 12/94; *Krasnaya Zvezda*, Nov 15/94)

November 12: A feature article described the Voyager spacecraft and the work of Paul Schenk, who had been a college summer intern at NASA's Jet Propulsion Laboratory in Pasadena, California and was now with the Lunar and Planetary Institute (LPI) in Houston. Schenk became fascinated with Voyager and its images. With his colleagues, Daniel G. Wilson and Robert D. Morris of LPI and Jeffrey M. Moore of NASA's Ames Research Center in Moffett Field, California, Schenk created stereo views of various bodies in the outer solar system using images provided by Voyager. (*Science News*, Nov 12/94)

November 13: NASA was learning to “fly leaner” as a result of a shrinking budget. Examples given were that launches now were no longer scheduled on weekends when overtime would need to be paid and if the weather were bad, liftoff was called off before fueling, saving \$400,000 in tanking costs. More than 1,400 Shuttle-processing jobs had been eliminated at the Kennedy Space Center in the previous three years and various Shuttle improvements had been deferred. (*W Times*, Nov 13/94)

- A feature article described the newly opened simulated space mission inside the Brownsburg, Indiana, Challenger Learning Center. It was one of 26 such centers across the country opened by the Challenger Center for Space Science Education. The program was founded by families of the Challenger crew. (*Indianapolis Star*, Nov 13/94)

- Space Shuttle Endeavour passed over four U.S. sites—forests in Michigan and North Carolina, waterways in Oklahoma, and desert lands in California—twice a day on its flight, allowing much data to be collected. Such data were now being studied as regarded Michigan’s Upper Peninsula and specifically, the Hiawatha National Forest. They would provide insights as to how forests were affected by timber-cutting, development, and global warming. (*Kalamazoo Gazette*, Nov 13/94; *Grand Rapids Press*, Nov 14/94)

November 15: Although the November 8 elections gave control of Congress to the Republicans, major changes in funding for the space program were not expected. This was the case despite the fact that Newt Gingrich, Republican from Georgia, who was expected to be the next Speaker of the House of Representatives, was an outspoken space advocate as was Representative Robert Walker, Republican from Pennsylvania and ranking Republican on the House Science, Space, and Technology Committee. NASA was already making plans to sell the Space Station program to the 11 freshman Senators and approximately 85 new House members who were to take office in January. (*SP News*, Nov 14-20/94)

- NASA announced that two teams of astronomers, working independently with NASA’s Hubble Space Telescope, had ruled out the possibility that red dwarf stars constituted the invisible matter, called dark matter, believed to account for more than 90 percent of the mass of the universe. The results increased the mystery of the missing mass because whatever dark matter was, its gravitational pull ultimately would determine whether the universe would expand forever or would someday collapse. Bruce H. Margon, an astrophysicist at the University of Washington at Seattle, in discussing the mystery of the missing matter, said “It’s a fairly embarrassing situation to admit that we can’t find 90 percent of the universe.” Various theories had been proposed by physicists, such as that neutrinos, electrically neutral subatomic particles produced prolifically in the Big Bang, had mass, or that the value of the cosmo-

logical constant, a concept invented by Albert Einstein, was low, helping to account for the difference between the observed density of matter and the critical density. (NASA Release 94-188; Reuters, Nov 15/94; *W Post*, Nov 16/94; *H Chron*, Nov 16/94; *C Trib*, Nov 16/94; *CSM*, Nov 17/94; *AvWk*, Nov 21/94; *NY Times*, Nov 29/94)

- NASA announced that a new satellite, the NOAA-J, a joint project of NASA, the National Oceanic and Atmospheric Administration, and the U.S. Air Force, was scheduled to be launched on December 4 from Vandenberg Air Force Base, California. The new satellite would circle the Earth every 102 minutes, passing over the North and South Poles on each orbit. The satellite would collect meteorological data and transmit them directly to users around the world to enhance local weather analysis and forecasting. (NASA Release 94-189)

- NASA announced the signing of a collaborative agreement of the chief executive officers of the nation's 28 largest aerospace contractors, NASA, and the U.S. Department of Education in a plan to improve the nation's mathematics, science, and technology education goals. The agreement was in furtherance of President Clinton's Goals 2000: Educate America Act, which he signed March 31, 1994. (NASA Release 94-190)

- NASA announced the selection of Orbital Sciences Corporation, Dulles, Virginia, as a contractor to provide launch services to deploy Ultralight-class payloads into their required orbits. (NASA Release C94-ii; *Htsvl Tms*, Dec 5/94)

- A feature article, accompanied by photographs of Mount Rainier and of the newly exploding Russian volcano taken from the radar images brought back by Space Shuttle Endeavour, commended the extraordinary quality of NASA's Spaceborne Imaging Radar. It discussed the process by which more than 500 sites were reviewed and gave particular attention to efforts to further define ancient Ubar, buried beneath desert sand. (*Newsday*, Nov 15/94)

November 16: NASA announced the resignation of Jeremiah W. Pearson as Associate Administrator for the Office of Space Flight and the appointment of Wayne Little as new Associate Administrator. (NASA Release 94-191; *AP*, Nov 16/94; *H Post*, Nov 17/94; *W Post*, Nov 18/94; *NY Times*, Nov 21/94; *AvWk*, Nov 21/94; *SP News*, Nov 21-Dec 4/94)

- NASA announced that 166 small, high technology firms located in 31 states had been selected for Phase II contract awards in NASA's Small Business Innovation Research Program. Funding for Phase II contracts could be up to \$600,000 for a two-year performance period. (NASA Release 94-192)

- NASA announced the near completion of a \$115 million restoration of a unique NASA wind tunnel located at Ames Research Center, Moffett Field, California, which began operating nearly 50 years ago. (NASA Release 94-193)
- NASA announced the selection of Science Applications International Corporation, of San Diego, California, for a contract to provide occupational safety, industrial hygiene, and environmental services to support NASA's Ames Research Center, Moffett Field, California. (NASA Release C94-jj)
- Richard DalBello, assistant director for space programs in the White House Office of Science and Technology Policy, said that NASA's competition for a reusable rocket to replace the Space Shuttle was on hold while White House budget officials mulled over the technical, financial, and political prospects for the program. The White House Office of Management and Budget must sign off on the NASA plan before NASA officials invited the U.S. aerospace industry to submit competing designs for the rocket. Most U.S. aerospace firms already had competing blueprints for a reusable rocket. (*SP News*, Nov 21-Dec 4/94)
- Space, Inc., a Clear Lake company, and its vice president Leonard N. Jackson, pleaded guilty in a Federal undercover probe of fraud among NASA contractors and employees. (*H Chron*, Nov 16/94)

November 17: Russia again postponed the launch of the Spektr research module, scheduled to rendezvous with Space Station Mir in December. Itar-Tass news agency reported that the launch had been postponed until May 1995. (Itar-Tass, Nov 17/94)

- The Russian President made an edict in mid-November establishing the state's first experimental space center at Plesetsk. The edict divided the Plesetsk facility, with one part being retained by the strategic missile forces and the other transferred to Russia's military space forces without, however, increasing logistical support, staffing, or pay. In contrast to Baikonur, for which Russia annually paid Kazakhstan \$116 million, the Plesetsk Space Center would give Russia its own launching site. From the Soviet era Plesetsk had nine launchpads and was the top secret site for launching more than half of all satellites. However, a critical state of electricity supply to industrial enterprises in Arkhangelsk Oblast had occurred, resulting from the payments crisis, which threatened a cut-off of electricity to Plesetsk and to Severodvinsk, where atomic submarines were built. (*Izvestiya*, Nov 17/94)

November 18: NASA announced the selection of 10 organizations to receive a total of \$6.8 million to help develop applications and technologies as part of NASA's efforts to stimulate public use of Earth and space science data over the Internet. (NASA Release 94-194)

- NASA announced the names of the remaining members of the second U.S. Microgravity Laboratory mission scheduled for the fall of 1995 aboard Space Shuttle Columbia. (NASA Release 94-195)

November 18: The celebration for the return of Space Shuttle Columbia to Palmdale, California for modifications and inspections was also the occasion for celebrating the return to work of some 200 laid-off Rockwell Corporation employees. (*Antelope Valley Daily News*, Nov 19/94)

November 19: France's national space agency CNES launched a public relations campaign featuring its astronauts in order to improve strained relations between CNES and the inhabitants of French Guyana on South America's northeast coast, where the Ariane rocket series was launched. The Guiana space center gave France independent launch capacity for civilian and military satellites. (Reuters, Nov 19/94)

November 20: Kevin Zahnle, a research scientist at NASA's Ames Research Center, Moffett Field, California, was quoted concerning the large amount of information gathered by spacecraft Galileo about Jupiter that would be lost because of the crippling of Galileo's communications capabilities. Nevertheless, much remained to be learned from the data already transmitted, as was seen at the recent meeting of the Planetary Sciences Division of the American Astronomical Society held in Bethesda, Maryland. (*Contra Costa Times*, Nov 20/94)

November 21: In connection with the November 21 field hearing in Spokane, Washington, of the Advisory Committee on Human Radiation Experiments, the media featured articles on tests performed on 131 prison inmates in Oregon and Washington from 1963 to 1971. The tests were sponsored by the Atomic Energy Commission in order to help determine how much radiation U.S. astronauts could safely bear during spaceflights. The testicles of inmate volunteers were irradiated in return for a small stipend. Classified documents dealing with the project were only made available recently. (*W Post*, Nov 20/94; *USA Today*, Nov 21/94; AP, Dec 5/94)

- U.S. firms such as Martin Marietta and Lockheed and the U.S. Air Force were interested in learning from the Moscow-based Design Bureau of Transport Machinery (DBTM) ways in which the United States could modernize its aging launch site structure. DBTM was working with Martin Marietta in evaluating upgrades to the company's Atlas launch sites. Lockheed was interested in Russian automated launch pad technology for its propose single-stage-to-orbit vehicle. The U.S. Air Force was impressed by the simplicity and operability of Russia's Zenith prelaunch process: "There is no need for human presence on the launch pad as the booster is automatically erected, connected, and launched." According to DBTM managers, the highly automated techniques

used at the Baikonur Cosmodrome Zenith launch site enabled two of the powerful boosters to be launched from the same pad within five hours. Robert Ford, Martin Marietta Astronautics' manager of Russian programs, said his firm was looking at seven potential jobs for DBTM on the Atlas launch pads, ranging from introducing higher levels of automation to controlling burn-off effects after each liftoff. In the future Martin Marietta might also have DBTM look at its Titan launching system as well. In other Russian-related activity, Martin Marietta was moving ahead on its evaluation of two Russian engineers for use on an upgraded Atlas. (*AvWk*, Nov 21/94)

- The retrieval of the German Crista-Spas satellite by Atlantis during its recent mission proved the validity of the rendezvous approach that NASA now planned to use for all dockings with Russia's Mir Space Station. Technical details were given of the "plus R bar" approach. (*AvWk*, Nov 21/94)
- During a visit to Cape Canaveral with his crewmates, Russian cosmonaut Vladimir Titov familiarized himself with the Spacehab module that was scheduled to be carried on his Shuttle flight in February 1995. (*AvWk*, Nov 21/94)
- Disagreements continued to exist between the United States and Russia over the Salyut FGB "space tug" with regard both to the tug's price and the cost of launching it, which Russia wanted the United States to pay. Khrunichev Machine Building Enterprise was in the early stage of working on the tug. An agreement was worked out on November 10 about the medical certification process for joint flights, under which each country would accept the medical certification of the other's space flight personnel until prelaunch examinations were performed 30-45 days in advance of Russian Soyuz flights and 10 days in advance of U.S. Shuttle flights. (*AvWk*, Nov 21/94)
- Rockwell Aerospace planned to deliver the Orbiter Docking System to NASA on November 21. To achieve a system that would enable a U.S. Shuttle to dock with Space Station Mir, Rockwell Space Systems Division integrated a Russian-built docking mechanism into the system. (*AvWk*, Nov 21/94)
- A feature article on Carl Sagan described his various accomplishments and mentioned his fascination with stargazing and his help to NASA in designing robotic missions, which he had been doing since the late 1950s. (*AP*, Nov 21/94)
- A Russian television program, "Science Today," commented on the roles of the Russian Energiya-Buran and the U.S. Space Shuttle systems in reducing the costs of placing payloads in space. In this connection the program promoted the potential of the Russian-Ukrainian project "Maks" based on an existing aircraft,

the Mriya. The Russian Maks program was commended by G. Le. Lozino-Lozinskiy, general designer of the "Molniya" and British Aerospace agreed it was necessary to begin building winged transport systems with the Maks and presented the Maks system to the European Space Agency. (FBIS-Sov, Nov 29/94)

November 22: NASA announced the signing of a contract with the Paton Welding Institute in Kiev, Ukraine, to develop a plan for flying a space welding tool aboard the Space Shuttle in October 1997. The Ukrainian Universal Hand Tool was an electron beam welding device developed at the Institute and used by Salyut 7 cosmonauts in 1984 and 1986 in the first electron beam welding in space experiments. (NASA Release 94-196)

- One of NASA's high-altitude, remote-controlled, Perseus research aircraft crashed, severely damaging the plane. NASA's Dryden Flight Research Center operated the craft, which was used to collect data from the upper reaches of the atmosphere—it could fly up to an altitude of 90,000 feet. (*Antelope Valley Press*, Nov 23/94; *H Chron*, Dec 5/94; *LA Times*, Dec 5/94)

November 23: NASA's Kennedy Space Center, Florida, announced the award of a life sciences support services contract to Dynamac Corporation, Rockville, Maryland. The contract supported Kennedy's Biomedical Operations and Research Office and the Payload Management and Operations Directorate in program management support for life sciences activities. The work included processing medical, biomedical, and biological flight experiments for launch and landing in addition to continuing research on NASA's Controlled Ecological Life Support System, a bioregenerative concept for long-term space travel. In addition, Dynamac would be responsible for environmental and ecological monitoring of Kennedy's premises, located on a national wildlife refuge. (NASA Release C94-kk)

- In a report by the House Government Operations Committee it concluded that NASA's sloppy management had resulted in some \$14 billion of NASA equipment—including computers and construction equipment—ending up in the hands of contractors. Moreover, NASA had failed to curb unallowable contract costs. Furthermore, NASA's recordkeeping was so bad that it was almost impossible to edit NASA's books. In addition, Committee chairman John Conyers, Democrat from Michigan, said NASA's "planning is so unrealistic that budgets are hopelessly optimistic." A report in another context concerning Houston's Johnson Space Center, dealt with equipment failures and human errors resulting from carelessness or stupidity. (*Tampa Tribune*, Nov 24/94; *O Sen Star*, Nov 24/94; *H Post*, Nov 30/94)

- NASA Administrator Daniel S. Goldin announced the appointment of Christopher C. Kraft, former Director of the Johnson Space Center, to form and lead an external independent team to review data from the Space Shuttle

Functional Workforce Review and make recommendation to Goldin for implementation. Kraft's team would be charged with evaluating the current process and procedures for Space Shuttle operations at the Johnson, Kennedy, Marshall, and Stennis Space Centers and related contractor activities in order to recommend a better operating structure. Initial efforts would focus on Kennedy operations. In addition to the Space Shuttle program, the team would review related Space Station activities. (NASA Release 94-197; *SP News*, Dec 5-11/94)

- NASA officials at Kennedy Space Center released their annual economic impact statement in terms of the effect of the Center on Brevard County. Despite budget cuts, the 1994 impact on the economy was \$1.18 billion in comparison to \$1.32 billion in 1992; the total workforce (including contractors, civil service, and construction) was 16,500 in 1994 in contrast with 18,700 in 1992. The review of NASA operations should result in more job cuts, which would occur in early 1995. (*Fla Today*, Nov 24/94)

November 26: Russian television on the "Aerospace Salon" program discussed various Russian space flights. The correspondent said that much was known about Salyut flights 1, 6, and 7 but nothing had been publicized about Salyut 2, 3, and 5 missions. It developed that the flight engineers for these missions were military cosmonauts and that they involved Almaz orbital reconnaissance stations. The Almaz hulls were launched as Salyuts, the first unsuccessfully in 1973 and two more in 1974 and 1976. A cosmonaut who flew on one of these, V.V. Gorbatko, was quoted as saying that the initial intention was to arm the Almaz station but the one on which he flew had reconnaissance equipment only. (FBIS-Sov, Nov 30/94)

November 28: The United States and Ukraine signed a five-year civil space agreement the week of November 21, which established direct cooperation between NASA and the Ukrainian National Space Agency and created the legal basis for bilateral scientific cooperation. The agreement, which provided for cooperation in such fields as remote sensing, telecommunications, biomedical sciences and biotechnology, and space research and technology, was described as "almost exactly the same" as the 1992 agreement with Russia. (*AvWk*, Nov 28/94)

- A scale model of Boeing's High Speed Commercial Transport was undergoing testing in the supersonic wind tunnel at NASA's Ames Research Center. (*AvWk*, Nov 28/94)

- NASA and contractor engineers were studying a number of existing engine designs as they tried to lower the propulsion technology risk for private development of a reusable launch vehicle (RLV) in the early 2000s. Operability rather than performance would be the key to any RLV engine. According to

Len Worlund, director of the Advanced Transportation Technology Office at NASA's Marshall Space Flight Center, to get reusability, NASA and its partners were working to build components that better withstood repeated firings. They were also trying to lower the high turbine temperatures that had saddled the Shuttle's engines with crack-prone cooling shields that required frequent repairs. (*AvWk*, Nov 28/94)

- Stanford research associate Stephen Morris said that Stanford had successfully designed, built, and flown a model of a supersonic "wing" that should ultimately be able to cut drastically the time needed to reach Tokyo or London from the United States. NASA and Stanford studies indicated that an oblique flying wing with a 400-foot wingspan could carry 400 passengers from Los Angeles to Tokyo in seven hours instead of the 10 hours now required. (*UP*, Nov 28/94)

November 29: After 12 years of work, Orion Network Systems, a Rockville, Maryland, firm, launched its first satellite. Orion was the first company to apply in 1982 to the Federal Communications Commission to provide international satellite communications. Orion won FCC approval in 1987 and Intelsat approval in 1989 on condition that it not harm any existing Intelsat business. Orion formed a consortium, Orion Atlantic, which included British Aerospace, which built the satellite, and Martin Marietta Corporation of Bethesda, Maryland, which provided the Atlas rocket. (*W Post*, Nov 30/94)

- NASA and Loma Linda University in California announced that NASA planned to use the University's Proton Treatment Center to find ways to protect astronauts in space. The University had the nation's only hospital-based proton treatment center for cancer. The program did not involve experiments on human subjects. (NASA Release N94-83; *Sun*, Nov 30/94)

November 30: China successfully launched a new telecommunications satellite, the Dongfanghong III, using a Long March 3A rocket from the Xichang base in Sichuan province, southwestern China. (*AFP*, Nov 30/94; Xinhua news agency, Nov 30/94)

- NASA announced a series of education telecasts for the 1994-95 school year featuring the following: the recent collision of comet Shoemaker-Levy, unique research in microgravity, the Earth's changing environment, and the diverse role of lasers in NASA technologies. (NASA Release 94-198)

- A laudatory assessment was given of NASA's Technology Transfer program with specific reference to the Marshall Space Flight Center. According to Harry Craft, Jr., Technology Transfer office manager, the program had three elements: Industrial Outreach, Space Act Cooperative Agreements, and Dual Use Programs. Each was intended to increase cooperation between government and industry. In the Industrial Outreach area, industries came to NASA with prob-

lems they needed to resolve, requiring less than 40 hours work. For more complex problems, Space Act Cooperative Agreements were used. The Dual Use Program was a technology reinvestment program in which both government and industry contributed funds and technology to benefit both parties. (*Huntsville News*, Nov 30/94)

November: A feature article commemorated the rendezvous on July 17, 1975 of the Soviet Space Ship Soyuz and the U.S. Apollo. The occasion was also used to discuss the new policy of Russian-U.S. cooperation in space and the forthcoming plan for Space Shuttle Atlantis to rendezvous with Russian Space Station Mir in 1995. (*Sky*, Nov 94)

- A lengthy article on the Clinton administration's science and technology policy dealt with these two fields and the President's goals in their regard. The government spent more than half of its research and development money on developing usable technologies. The remainder was divided almost evenly between applied research and basic research. However, the availability of funding was a serious problem. Funding increased significantly during the Cold War but scientific disasters such as the failure of a nuclear reactor at the Three Mile Island electric power plant and the explosion of the Challenger Space Shuttle eroded public support and federal funding. The accomplishments of the National Science and Technology Council (NSTC) in consolidating the two weather satellite systems of the Defense Department and the National Oceanic and Atmospheric Administration as well as the NSTC's initiative in coordinating space launch policy among NASA and the Defense, Commerce, and Transportation departments were commended. (*Government Executive*, Nov 94)

- The fact that each year a Space Shuttle liftoff was seen as more unremarkable than the preceding year testified to the small and particular miracles of engineering, mechanics, and electronics that made each mission fly. The process of mating the orbiter to an enormous external fuel tank and two solid rocket boosters, constituting the Shuttle, was described in some detail as well as the fueling of the Shuttle. (*Destination Discovery*, Nov 94)

- A discussion of enthusiastic hobbyist rocketeers involved in model and high-power rocketry contrasted this with NASA's programs and bore the title, "Tired: NASA; Wired: Amateurs." (*Wired*, Nov 94)

December

December 1: Possible evidence of a new planetary system only 52 light-years away arising from observation of a star named Beta Pictoris was published in *Nature*. Harold F. Levinson and colleagues at the Southwest Research Institute in San Antonio showed how a system of planets and comets could account for the phenomena seen near the star. NASA's Hubble Space Telescope enabled some of these new discoveries. Planet hunter Charles M. Telesco at NASA's Marshall Space Flight Center in Huntsville, Alabama said of Levinson's work, "Whenever you can put a body of evidence into a coherent picture like that, everybody feels much better." (CSM, Dec 1/94; *H Post*, Dec 1/94)

- NASA named John C. Lynn to head the new office of Chief Information Officer within the Office of the Administrator at NASA Headquarters in Washington, DC (NASA Release 94-199)

- Western Europe's 70th Ariane rocket sent a U.S. PanAmSat communications satellite worth more than \$150 million plunging into the Atlantic Ocean off French Guyana after its third stage malfunctioned. This was the second Ariane rocket failure in 1994 and the seventh since Western Europe began launching the Ariane series in 1979. (Reuters, Dec 1/94)

- The group of scientists from Phillips Rocket Laboratory investigating the disappearance of the Mars Observer more than one year ago concluded the probable cause of the accident. Phillips aeronautical engineer and project manager said the likely cause was failure of a small pyro valve that allowed propellants to mix. This in turn could cause the rupture of a tube and result in the Observer tumbling out of control. (*Antelope Valley Press*, Dec 1/94)

December 2: David R. Proctor, a NASA engineer, pleaded guilty to one count of conspiracy, three counts of bribery, one count of violating Federal procurement regulations, and one count of accepting a gratuity in a case involving Operation Lightning Strike. The case resulted from his actions in relation to an FBI agent posing as a corrupt businessman seeking a NASA contract. (*H Chron*, Dec 3/94; *H Post*, Dec 3/94; AP, Dec 3/94)

- Johnson Space Center denied one of its largest prime contractors, Martin Marietta Services of Cherry Hill, New Jersey, an "award fee" or profit on its contract for the six-month period ending March 31, 1994. The action resulted from a much more stringent contract compliance policy by NASA and the fact that the contractor did not control its labor costs under the terms of the contract. (*H Chron*, Dec 3/94)

- Eleven District of Columbia students from Ballou Senior High School and Johnson Junior High School took part in a week-long NASA Space Camp in

Huntsville, Alabama. They all earned certificates, wings, and a space outfit as well as one college credit from the University of Alabama. (*Washington Afro-American*, Dec 3/94; *W Times*, Dec 5/94)

December 4: Astronaut Frank Culbertson, charged with helping to arrange the series of Shuttle missions to Russian Space Station Mir, discussed some of the frustrations of working with the Russians and the American need for patience and flexibility, given the linguistic, cultural, and economic differences between the two countries. Culbertson indicated that the initial Russian response to U.S. requests was "No" and that, for example, the Russians had withheld key information about the explosive charges, which were developed for a military program, that were involved in the Russian latching mechanism that would enable U.S. Shuttle Atlantis to dock with Mir. Another problem was the delay in getting U.S. astronaut Norman Thagard's equipment to Mir. A longer range hitch entailed the Russian guidance and propulsion module being built for the U.S. International Space Station. So far the Russians had received a U.S. commitment of \$25 million for the component but it appeared they wanted up to \$245 million. When Thagard was interviewed about U.S.-Russian space work, he said that it would seem that thus far the two had managed to make their cooperation work. (*H Chron*, Dec 4/94)

- The proposed merger of Martin Marietta Corporation and Lockheed Corporation was analyzed. The result would be not only the world's largest defense company but also, according to the writer, "the most politically powerful" because of its lobbying clout. The new firm would excel particularly in missiles and jets. The proposal caused numerous rumors of other merger efforts by defense firms. (*O Sen Star*, Dec 4/94; *W Post*, Dec 6/94)

- NASA's attempts to streamline its management of space programs and cut costs were highlighted with details of personnel cuts and commendation of the efforts of Jeremiah Pearson who had served as Associate Administrator for Space Flight. An example of Shuttle and Space Station mergers was the Johnson Space Center's new \$250 million Mission Control Center. The Center could handle Shuttle missions, activities aboard the Mir, and the new International Space Station simultaneously. (*H Chron*, Dec 4/94)

December 5: New Republican House Speaker Newt Gingrich indicated in an interview that he favored a NASA confined to research and development, with remaining functions contracted out to the private sector as far as possible. His overriding mission for NASA was drastically reducing the cost of getting into space. Gingrich praised NASA Administrator Daniel S. Goldin's efforts to reshape NASA but considered the agency still to be "a people-heavy, obsolescent bureaucracy." (*AvWk*, Dec 5/94)

- Jack Mansfield, who was named in September 1994 as NASA Associate Administrator for Space Access and Technology, discussed his position and the Reusable Launch Vehicle (RLV) program in an interview. Previously he served as a Republican staff member on the Senate Armed Services Committee but he did not consider this past affiliation a problem because NASA deserved and got strong bipartisan support. With regard to the RLV program, Mansfield said that in the past NASA had been able to solve all technical problems but not always all operability problems, such as high cost—this was where the use of a RLV came in. (*SP News*, Dec 5-11/94)
- According to NASA Administrator Daniel S. Goldin, NASA received 28 outstanding proposals from universities, the aerospace industry, and government laboratories for smaller, less expensive planetary science missions under its new Discovery program. By January 1995 NASA was to select a few to pursue seriously with the expectation that one or two would be developed and launched by the period 1999-2001. NASA set forth specific funding limitations and wanted models of streamlined management of such projects while demanding high quality. (*AvWk*, Dec 5/94)
- Johns Hopkins University's Applied Physics Laboratory (APL) was making components and expected to integrate the Near Earth Asteroid Rendezvous (NEAR) by early June 1995. NEAR was the second mission approved in NASA's Discovery program but would be the first to be launched. To make a scheduled January 1999 encounter with 433 Eros—a silicate rock asteroid—NEAR would need to be launched within a two-week period beginning February 17, 1996. It would be launched on a Delta 2 and would swing by Earth in 1998 so that its plane could be changed to match that of Eros. The spacecraft would carry four instruments: a visible imager, an X-ray/gamma-ray spectrometer, a near infrared spectrograph, and a magnetometer. In entrusting to APL its first planetary science mission to be developed outside the Agency, NASA turned to a laboratory experienced in rapid, inexpensive space programs. APL was responsible for three other proposals that NASA was considering under the Discovery program. (*AvWk*, Dec 5/94)
- Mars Pathfinder, the first of NASA's Discovery missions, was beginning construction in preparation for launch in two years' time. Anthony J. Spear, project manager for the Mars Pathfinder project at the Jet Propulsion Laboratory in Pasadena, said fabrication of the cruise portion's structure had begun; final assembly of the spacecraft was to begin in June 1995. Testing of various kinds would follow with the spacecraft being shipped to Cape Canaveral for launch by early September 1996. The primary goal was an engineering demonstration of a low-cost Martian landing system. (*AvWk*, Dec 5/94)
- Lockheed said it could arrange private financing for a low-cost, reusable launch vehicle (RLV) if the U.S. government would give it all the Space

Shuttle and Titan business for at least five years. In return, Lockheed estimated that the government would get \$2 billion a year savings. To make such a RLV, Lockheed would call on Rocketdyne for propulsion, Rohr Corporation for high temperature structures, and Martin Marietta-Denver for tanks for liquid oxygen and hydrogen. (*AvWk*, Dec 5/94)

- The French national space agency CNES proposed for government approval developing a series of small spacecraft to broaden science mission opportunities at lower cost. If approved in 1995, France would invite other European countries or the United States to participate. According to Pierre Contreras, head of the System Engineering Division at the CNES Toulouse Space Center, satellites weighing about 500 kilograms were contemplated. The first flight would be a radar altimeter spacecraft designed as a follow-on to the NASA/CNES TOPEX/Poseidon sea surface topography mission currently underway. The chairman of the European Space Agency's (ESA) Space Science Advisory Committee, Lodewijk Woltjer, said that all ESA members "like the idea of small missions because of their low costs, but for most of ESA's objectives small satellites are too small." (*AvWk*, Dec 5/94)

December 6: After three years of testing by NASA's Langley, Virginia, research center, the airline industry, industry suppliers, and the Federal Aviation Administration, a new device was approved to alert pilots of wind shear danger. Called the Bendix RDR-4B, it was made by Allied Signal Inc. in Morristown, New Jersey and was being installed by various commercial airlines. The device complements ground-based wind-shear detection systems, known as Terminal Doppler Weather Radars, being installed at 47 major U.S. airports. (*W Times*, Dec 6/94)

- NASA announced that astronomers using its Hubble Space Telescope had obtained the clearest views yet of distant galaxies that existed when the universe was a fraction of its current age. Hubble findings suggested that elliptical galaxies developed quickly into their present shapes. However, spiral galaxies in large clusters evolved over a much longer period. (NASA Release 94-201; *Reuters*, Dec 6/94; *NY Times*, Dec 7/94; *W Post*, Dec 7/94; *W Times*, Dec 7/94; *H Chron*, Dec 7/94; *USA Today*, Dec 7/94; *CSM*, Dec 7/94; *H Post*, Dec 7/94; *Newsweek*, Dec 19/94)

- NASA announced that it had selected eight projects that could lead to new private sector applications of space-based and airborne sensing technologies. Named Earth Observations Commercial Applications (EOCAP) '94, the projects represented the fourth cycle in a continuing program designed to increase use of NASA-developed technology for gathering and analyzing valuable data about Earth and ocean resources through remote satellite or aircraft observations. (NASA Release 94-203)

- The \$20 million docking ring, known as the Androgynous Peripheral Docking System, which would enable Space Shuttle Atlantis to dock with Russian Space Station Mir in 1995, arrived from Russia after it had been tested in Russia, in California, and in orbit. NASA managers expressed confidence in the ring although they could not read the Russian plaque on it. (*O Sen Star*, Dec 7/94; *Fla Today*, Dec 7/94)

- NASA scientists would like to send an unmanned spacecraft to look for ice inside craters on Mercury, the solar system's hottest planet with temperatures reaching 800 degrees at its equator. However, inside the craters at Mercury's poles the temperatures were 235 below zero and scientists conceived that life might exist. Robert M. Nelson of NASA's Jet Propulsion Laboratory (JPL) in Pasadena discussed JPL's proposal for a mission to Mercury, named Hermes, which NASA was considering. The discussion occurred at a meeting of the American Geophysical Union. (*AP*, Dec 6/94)

December 7: NASA was preparing to move to a new Mission Control room in 1995 for the first time since 1965. Of particular concern was the new world of computer linkage that was challenging security-minded planners. The planners feared various security problems related to computers including sabotage, computer viruses, software imperfections, and confidentiality of data. (*H Post*, Dec 7/94)

- Scientists of NASA's Jet Propulsion Laboratory in Pasadena, California, which managed the U.S.-French TOPEX/Poseidon oceanography satellite, had been studying data it developed. The findings from two years of monitoring the oceans, which were to be announced at the fall meeting of the American Geophysical Union in San Francisco, indicated that the average sea level had risen about 0.12 inches a year from December 1992 to September 1994. Such a rise was an indicator of global change and supported theories that an increase in "greenhouse" gases was causing long-term global warming. (*Pasadena Star News*, Dec 7/94)

- An interview was published with retired Princeton physicist Freeman Dyson in which he strongly criticized NASA. He advocated that NASA be dismantled like AT&T, feeling it was overly expensive and inefficient. Instead, science should be done by individuals following their own curiosity and creativity. (*CSM*, Dec 7/94)

- NASA announced that scientists at its Marshall Space Flight Center in Huntsville, Alabama, were observing rare gamma ray flashes above thunderstorms at a rate six times that of previous observations. Steve Goodman of Marshall's Space Sciences Laboratory said the observations were being made by the Burst and Transient Source Experiment aboard NASA's Compton Gamma Ray Observatory, which was recently modified by ground commands to be more sensitive to such events. NASA planned to bring together inves-

tigators from the fields of space and atmospheric physics to study the newly discovered events. (NASA Release 94-204; AP, Dec 7/94)

December 8: NASA announced the names of 19 new astronaut candidates for the Space Shuttle program. The 1995 group consisted of 10 pilots and nine mission specialists, including six civilians and 13 military officers, all chosen from among 2,962 applicants. International candidates were also to be included and these names would be announced later. (NASA Release 94-205)

- NASA Administrator Daniel S. Goldin made a state-of-the-agency address to all staff members in which he stressed that NASA intended to become less costly and quicker during the next four years, ending with as many as 4,000 fewer workers. Kennedy Space Center Deputy Director Gene Thomas, who answered questions after the televised address, said it would be a year of "significant change." (*O Sen Star*, Dec 9/94)

- Construction was getting underway on the Space Station project according to John Winch, Boeing Defense and Space Group manager in charge of building the habitation and laboratory models for the Station. Boeing workers were about to go on a three-shift, five-day week to expedite the program. (*Fla Today*, Dec 8/94)

December 9: NASA announced the appointment of Larry DeLucas, a former Space Shuttle payload specialist and an expert in protein crystallography, as acting senior scientist for the Space Station. (NASA Release 94-206; Phillips Business Information, Dec 14/94)

- NASA announced that students in the United States would be able to see and talk to scientists in Antarctica during unique educational broadcasts from the South Pole beginning December 13. (NASA Release 94-207)

- Kathryn Hire, who worked at Kennedy Space Center (KSC) for Lockheed Space Operations Company, became the first KSC worker to be selected as a future astronaut. (*O Sen Star*, Dec 9/94)

December 10: When Tropical Storm Gordon blew through Florida in November, a tugboat pulling NASA's \$50 million external fuel tank for Shuttle Atlantis lost power and was rescued by a tanker. The tanker could claim salvage rights from NASA or claim the tank, and NASA had no insurance to cover law suits on the fuel tank. (*O Sen Star*, Dec 10/94)

December 11: NASA determined it was cheaper to tear down the giant hammerhead crane originally built for the Apollo Moon landing program rather than to refurbish it. Therefore, the crane was in the process of being dismantled at the Kennedy Space Center launch pad. (*Fla Today*, Dec 11/94)

December 12: NASA announced the members of the crew of the Space Shuttle mission for the fall of 1995 under the command of Brian Duffy. A Japanese National Space Development Agency specialist was included and one of the mission objectives was to retrieve a science satellite scheduled to be launched by a Japanese H-2 rocket in early 1995. The Shuttle would also retrieve another science satellite, the Shuttle Pointed Autonomous Research Tool for Astronomy (SPARTAN). In addition, two spacewalks would be conducted. (NASA Release 94-208)

- NASA announced the development and testing of a new integrated flight and propulsion control system to help pilots land under difficult conditions. Aerospace engineers at NASA's Ames Research Center, Moffett Field, California, were developing the digital fly-by-wire control system to reduce a pilot's workload and help stabilize landing aircraft. NASA was testing the new system in the Vertical/Short Takeoff and Landing (V/STOL) Systems Research Aircraft (VSRA) to improve takeoff and landing capabilities for V/STOL aircraft in reduced visibility. The VSRA was a modified version of the U.S. Marine Corps' AV-8B Harrier jet fighter, which could take off and land vertically. (NASA Release 94-209)

- NASA announced the death of Stuart Allen Roosa, one of six Apollo astronauts to fly solo around the Moon. (NASA Release 94-210; UPI, Dec 13/94; *O Sen Star*, Dec 13/94; *Fla Today*, Dec 13/94)

- NASA announced the release of EOSDIS Version O to users in the Earth Observing System (EOS) community. The release was NASA's first step in developing a nationwide, globally available data system that would provide a variety of users with information needed to make informed decisions about how humans could control their environment. Ultimately, EOSDIS would serve several functions such as controlling EOS spacecraft, relaying raw data to the data processing centers, and through its Distributed Active Archive Centers (to be located at eight sites around the country) serving as a fountainhead of information. (Unnumbered NASA Release)

- France planned on its next manned mission to Russian Space Station Mir in January 1996 to use an advanced Aerospatiale system called Alice 2 to improve knowledge of fluid behavior in microgravity conditions for use in materials processing. (*AvWk*, Dec 12/94)

- A feature article gave high praise to the achievements of the Hubble Space Telescope quoting John N. Bahcall, professor of natural science at the Institute for Advanced Study at Princeton University, as saying "Hubble is bowling us over every day with what it does." A number of Hubble's discoveries were outlined, including data on the age of the universe, the Big Bang theory, and the size of the universe. (*P Inq*, Dec 12/94)

December 13: John F. Kennedy Space Center Director Robert L. Crippen announced he would leave NASA January 21 after more than 25 years with the Agency. Crippen indicated in a press conference that NASA budget slashing had made him uncomfortable and concerned about the safety of Shuttle missions. (NASA Release 94-211; *C Trib*, Dec 13/94; *O Sen Star*, Dec 13/94; *Fla Today*, Dec 13/94; *H Post*, Dec 14/94; *CSM*, Dec 14/94; *Fla Today*, Dec 14/94)

- NASA announced it had begun planning for a new multidisciplinary life and microgravity sciences Spacelab research mission to be flown on Space Shuttle Columbia in mid-1996. (NASA Release 94-212)

December 14: Students and teachers at Alvin High School in Texas, with the assistance of a neighboring community college and members of the Consortium for Aerospace Technology Education (CATE), were building their own space center similar to that at the Control Center Complex of NASA's Johnson Space Center (JSC). Frank Hughes, chief of the Flight Training Division at JSC, initiated the CATE program, which integrated cooperation from industry (Rockwell) with that of community colleges and universities. (*H Chron*, Dec 14/94)

- NASA and Russian Space Shuttle mission managers met at Johnson Space Center and announced that they were targeting a launch date between June 8 and June 10 for Shuttle Atlantis and its five-astronaut, two-cosmonaut crew. This represented a postponement of the original blast-off date of May 24 and resulted from a delay from February to May 1995 in the launch of a Russian Spektr science module. The launch of Atlantis was scheduled to be followed three days later by a docking with Russian Space Station Mir. (*Fla Today*, Dec 15/94; *H Chron*, Dec 17/94)

- NASA announced the establishment of a joint government research program that might result in developing plants that could withstand drought, unseasonable temperatures, soil salinity, and other adverse growth conditions. The program, called the Research Network on Plant Sensory Systems, was supported by NASA and the National Science Foundation. The program also was selected as NASA's ninth Specialized Center of Research and Training. (NASA Release 94-213)

- Representative Robert Walker, Republican from Pennsylvania, who was scheduled to chair the House Science Committee in the new Congress, said he felt that Space Station appropriations by Congress were safe. He indicated he wanted to explore ways of linking NASA facilities with universities and international partnerships as well as tax incentives for space business development, all of which he saw as ways of saving space funds. (*AP*, Dec 14/94; *Gannett News Service*, Dec 14/94; *H Chron*, Dec 15/94; *Congressional Quarterly's Congressional Monitor*, Dec 15/94; *Fla Today*, Dec 15/94)

- The deed to NASA's Computer Complex in Slidell, Louisiana was transferred to the city of Slidell at a ceremony attended by NASA Acting Deputy Administrator General John R. Dailey among others. For more than 30 years, the Slidell complex had provided support for the Space Shuttle external tank program as well as other Office of Space Flight administrative and program activities. However, these functions recently were moved to NASA's Marshall Space Flight Center in Huntsville, Alabama. Various plans were underway for ways in which the Slidell facilities could be used. (*Sentry News*, Dec 15/94)

December 15: NASA Administrator Daniel S. Goldin named Jay F. Honeycutt as Director of the John F. Kennedy Space Center upon the departure of Robert L. Crippen on January 21, 1995. (NASA Release 94-214; AP, Dec 15/94; *Fla Today*, Dec 16/94; *O Sen Star*, Dec 16/94; *H Chron*, Dec 16/94; *H Post*, Dec 16/94; AP, Dec 16/94; *W Post*, Dec 17/94; *Fla Today*, Dec 18/94; *O Sen Star*, Dec 20/94; *Fla Today*, Dec 20/94)

- Findings about the Moon resulting from the 71-day rendezvous of the military probe Clementine were reported at the recent American Geophysical Union meeting. It developed, according to geophysicist Maria Zuber of Johns Hopkins University and NASA's Goddard Spaceflight Center, that "Now we know that we don't understand the Moon as well as we thought we did." Instead of no activity on the Moon in the preceding three million years, there was volcanic activity as recent as one billion years ago. The crust was very variable and the Moon had a crater large enough to span the continental United States as well as another fresh-looking crater created by an impact recorded by 12th century monks. (*LA Times*, Dec 15/94)

- A solid-fuel booster for Ariane-5, the new rocket designed to keep Western Europe in the lead in launching heavy satellites into the 21st century, was tested successfully in the jungles of French Guyana, according to Jean-Marc Artaud, Ariane-5 program director for the CNES French national space agency in Guiana. (Reuters, Dec 16/94)

- A leak of toxic rocket propellant on an Air Force Titan 4 rocket forced the postponement of the rocket's launch to December 20. (*Fla Today*, Dec 17/94; *Fla Today*, Dec 18/94; *O Sen Star*, Dec 20/94; *Fla Today*, Dec 20/94)

December 16: NASA announced the selection of Boeing Information Systems, Inc., Vienna, Virginia, for a contract to provide information resources and management support services to NASA Headquarters, Washington, DC. (NASA Release C94-11)

- A Youth Science Symposium, "Your Place in Space," drew 400 middle school students to the California Museum of Science and Industry. Randii Wessen, a science systems engineer with NASA's Jet Propulsion Laboratory in Pasadena, was an instructor in one of the space-age exercises. Other students

launched rockets and learned the fundamentals of comets and rockets. (*LA Times*, Dec 16/94)

- NASA officials indicated that details of scientific evidence supporting the theory that man-made chlorine was causing the ozone hole above Antarctica would be released on December 19. The evidence was based on three years of data from NASA's Upper Atmosphere Research Satellite (UARS). UARS instruments had found chlorofluorocarbons (CFCs) used in electronics and refrigeration systems in the stratosphere. The stratospheric ozone layer was responsible for protecting people, animals, and plants from too much ultraviolet sunlight. (Reuters, Dec 16/94; *W Post*, Dec 17/94; NASA Release 94-215; *UP*, Dec 19/94; Reuters, Dec 19/94; *LA Times*, Dec 20/94; *NY Times*, Dec 20/94; *W Post*, Dec 20/94; *W Times*, Dec 20/94; *USA Today*, Dec 20/94; *WSJ*, Dec 20/94; *O Sen Star*, Dec 20/94; *Fla Today*, Dec 20/94; *H Chron*, Dec 20/94; *H Post*, Dec 20/94; *C Trib*, Dec 20/94; *AP*, Dec 20/94)

- One of the six ball-screw housings, the \$95 million Russian docking system shock absorber, failed its test and the Russian builder wished to replace all six. This might delay the June 8, 1995 launch of Shuttle Atlantis to dock with Russian Space Station Mir. (*O Sen Star*, Dec 15/94)

December 16: U.S. Vice President Al Gore and Russian Prime Minister Viktor Chernomyrdin signed a number of cooperation agreements in Moscow. The agreements included one to conduct joint space research to gather data on the Earth's atmosphere and to cooperate on the International Space Station. According to Yuriy Koptev, director of the Russian Space Agency, the agreement with NASA concerning the Earth's atmosphere provided for U.S. instruments for measuring the ozone layer and atmospheric components to be installed on Russian Meteor-3 satellites scheduled to be launched in 1996 and 1999. Agreement was also reached on a joint program of biological experiments under which two Russian Bion satellites with U.S. equipment were to be launched. Gore and Chernomyrdin also signed a customs agreement providing for duty-free clearance of goods shipped to Russia for cooperation in space, which would remove barriers causing delays in the Space Station program.

Also among the agreements was one concerning space medical research. In that connection, Arnauld Nicogossian, NASA's Washington-based chief medical officer, said the space agencies of the two countries planned to spend about three months working out details. NASA proposed to offer \$500,000 in equipment, materials, and money to enable the Russians to establish a Space Biomedical Center for Training and Research near the Moscow State University and Russia's Institute of Biomedical Problems. Russia would be expected to contribute a similar amount. The U.S. counterpart to the Russian training and research center would be at NASA's Johnson Space Center in Houston, where officials planned to establish a similar alliance of university and commercial medical research institutions. (Reuters, Dec 16/94; *UP*, Dec

16/94; Interfax news agency, Dec 16/94 quoted in *BBC Summary of World Broadcasts*, Dec 19/94; Phillips Business Information, Dec 19/94; Phillips Business Information, Dec 22/94; *H Chron*, Dec 23/94)

- NASA was preparing three rendezvous with Russian Space Station Mir to launch the new cooperative effort between Washington and Moscow. In the first, scheduled for February 1995, Shuttle Discovery would simulate docking with Mir but not in fact touch it. In June 1995, Shuttle Atlantis would actually dock with Mir and remain together for four days, ultimately taking aboard U.S. astronaut Norm Thagard who would have joined Mir in March. In October 1995, Atlantis would be outfitted with an Orbiter Docking System that would be installed on the Space Station to facilitate future rendezvous. (AFP, Dec 16/94)

- Larry DeLucas, recently appointed chief scientist of the NASA Space Station project, said the Station provided the next step for businesses such as pharmaceutical companies that were trying to develop new and improved products such as high quality crystals, uninhibited by the Earth's gravitational environment. (Phillips Business Information, Dec 22/94)

December 17: An audit report by NASA's inspector general, which was still in draft, noted that NASA could have saved almost \$6 million in business travel costs in 1993 by flying available commercial flights instead of using NASA aircraft. As a result, NASA planned to rewrite rules for the use of its planes, according to Laurie Boeder, Associate NASA Administrator for Public Affairs. Jack Anderson's column contained a critical account of NASA travel concentrating on NASA Administrator Daniel S. Goldin's use of NASA aircraft in the six-month period from October 1, 1992 through March 31, 1993, which reportedly cost taxpayers \$514,000 more than if he had flown a commercial airline. (*Fla Today*, Dec 17/94; *W Post*, Dec 19/94)

December 19: A NASA delegation led by Mike O'Brien from NASA's External Affairs Division in Washington was in Moscow to present to Russian officials the draft of the Memorandum of Understanding (MOU) concerning the International Space Station. The MOU detailed services to be provided by Station partners and the percentage of Station resources—power, water, storage space—each would receive. Bill Shepherd, deputy program manager for NASA's Station program, was optimistic about the Russian response to the MOU and also optimistic about NASA's purchase of the 20-ton FGB navigation and propulsion tug (the first Station component to be sent up) from Lockheed-Khrunichev. (Phillips Business Information, Dec 19/94)

December 20: A feature article described some of the findings of spacecraft Ulysses, which used Jupiter's gravity to enter an orbit perpendicular to those of the planets and for the preceding four months had been studying the Sun's polar regions.

These were hitherto unexplored areas, and Ulysses mapped the Sun's magnetic field and its cosmic rays, providing a wealth of data about solar dynamics. Ulysses was launched from a Space Shuttle in October 1990. (*NY Times*, Dec 20/94)

- NASA spokesperson George Diller said that as a result of an engine leak discovered in California, NASA had decided to check the welds on all engine nozzles of Space Shuttle Discovery. This fact, combined with the decision to replace one of Discovery's auxiliary power units, might result in a delay of the scheduled February 2, 1995 launch of Discovery. (*O Sen Star*, Dec 20/94)

- NASA announced the highlights of its 1994 activities and provided a chronology of major space events. Of particular note were the flight of a Russian cosmonaut aboard a U.S. spacecraft for the first time and a spectacular cosmic collision that occurred on Jupiter. However, it was the work of the refurbished Hubble Space Telescope that dominated NASA news in 1994. Among Hubble results were the following: evidence of a massive black hole in the center of a galaxy 50 million light-years away, supporting Einstein's theory of relativity; observations of huge pancake-shaped disks of dust, raw material for planet formation, swirling around half the stars in the Orion Nebula; confirmation of a critical prediction of the Big Bang theory that helium should be widespread in the early universe; and significant progress in determining the age of the universe—between 8 and 12 billion years—and its size. (NASA Release 94-216; UPI, Dec 22/94)

- NASA unveiled its new Mission Control Center in Houston with a flight simulation that pretended to rendezvous a Space Shuttle with a satellite. The demonstration went well and provided an opportunity to identify additional equipment needed, such as more display facility. The new center should be directing the Shuttle in orbit by the summer of 1995. (*Federal Computer Week*, Dec 20/94; *H Post*, Dec 21/94)

December 21: NASA announced the completion of the second of two shipments of solar panel modules, marking delivery of the first U.S. Space Station flight hardware for NASA's cooperative space endeavours with Russia. The shipments each consisted of 45 solar panel modules developed for the Mir cooperative solar array project, an effort that brought together NASA's advanced photovoltaic technology with Russia's proven structures and mechanisms. Eighty-four of the modules were scheduled to be integrated with Russian-made frames in 42 hinged parts. The completed array would be returned to the United States to be taken to Mir on the Space Shuttle Atlantis mission scheduled for October 1995. (NASA Release 94-217; Phillips Business Information, Dec 22/94)

- NASA announced the award of a supplemental agreement to Martin Marietta Astro Space of the Martin Marietta Corporation East Windsor, New Jersey. The agreement provided for two additional advanced meteorological

satellite spacecraft through the Television Infrared Observation Satellite project contract at the Goddard Space Flight Center, Greenbelt, Maryland. (NASA Release C94-mm)

December 22: NASA Associate Administrator for Space Science, Wesley T. Huntress Jr., announced the selection of a scientific investigation that included the development of a new camera for the Hubble Space Telescope (HST). NASA was scheduled to work with Holland Ford of Johns Hopkins University, Baltimore, to develop a new camera, called Hubble Advanced Camera for Exploration. The new camera would be installed on the HST by Shuttle astronauts during the third servicing mission scheduled for November 1999. (NASA Release C94-00)

- NASA announced the preliminary findings of the investigating team at NASA's Dryden Flight Research Center, Edwards, California. The findings indicated that a faulty vertical gyro was responsible for the accident November 22 that resulted in severe damage to a Perseus remotely piloted research aircraft. (NASA Release 94-218)

- Charles Bigot, chairman of Arianespace, told a news conference that the company hoped to resume launches of Ariane missiles in two months' time. Following the failure of the December 1 launch, which sent an American PanAmsat-3 communications satellite to the bottom of the Atlantic, 21 corrective measures had been taken. French-based Arianespace had captured more than 60 percent of the world's satellite launch market and had orders to launch 37 satellites. (Reuters, Dec 22/94)

December 28: NASA announced that its scientists now believed that it was the sulfur-rich atmosphere created in the aftermath of an immense asteroid collision with Earth 65 million years ago that brought about a global freeze and the demise of the dinosaurs. According to planetary geologist Adriana C. Ocampo and atmospheric scientist Kevin H. Baines, both of NASA's Jet Propulsion Laboratory's Earth and Space Sciences Division, Pasadena, California, the impact of this asteroid hit a geologically unique, sulfur-rich region of the Yucatan Peninsula in Mexico. They estimated that the impact kicked up billions of tons of sulfur and other materials and was between 10,000 to 50,000 times more powerful than the comet Shoemaker-Levy 9 impact on Jupiter the preceding July. Persistent clouds generated by this impact caused temperatures to plunge globally to near freezing. These environmental changes lasted for a decade, causing half of the species on Earth to become extinct. (NASA Release 94-219)

December: A feature article, accompanied by extensive photographs, discussed the capabilities of the radar systems carried by Space Shuttle Endeavour and the new perspective they provided of the Earth's environment. (*Scientific American*, Dec 94)

ASTRONAUTICS AND AERONAUTICS CHRONOLOGY **1995**



January

January 2: Data from NASA's Upper Atmospheric Research Satellite indicate that chlorofluorocarbons (CFCs) are responsible for the destruction of Earth's protective stratospheric ozone layer. By mid-1995, the amount of methyl chloroform in the atmosphere was found to have begun to decrease, although the Antarctic hole in the ozone grew significantly. (NASA Release 95-115; *NY Times*, Jul 16/95, Aug 3/95, Oct 12/95 & Nov 29/95; *W Post*, Jul 14/95, Sep 13/95; *W Times*, Oct 12/95; UPI, Sep 20/95; *AvWk*, Jan 2/95; *Science*, Oct 20/95)

- The United States and Russia began taking practical steps toward merging their manned space programs. NASA expected to begin shuttle flights to the Mir Space Station as a step in a joint venture to build a space station. The agreement called for seven flights through 1997 in which U.S. space shuttles would dock with Mir and allow the exchange of crews. One shuttle mission in 1995 would supply solar arrays that would combine U.S. advanced photovoltaic technology with Russia's expertise in space structures and mechanisms in order to boost Mir's electrical output by six kilowatts. (*AvWk*, Jan 2/95; *San Diego Union-Tribune*, Jan 4/95)

- Scientists at the University of Chicago advanced a new theory explaining the "mass extinctions" of living species that have occurred on Earth, the most famous being that of the dinosaurs 65 million years ago. They theorized that supernovas burned off the Earth's ozone layer and caused the Sun's rays to flood the surface with deadly radiation. The theory borrows from work done on the effect of ozone depletion in Antarctica. Scientists estimate that five mass extinctions have occurred on Earth, one every 120 million years. (*AP*, Jan 2/91; *C Trib*, Jan 3/95)

- NASA selected the IBM Thinkpad 755C as the Space Shuttle's new standard portable computer. It will supplement the Shuttle's computing capability and manage in-orbit activities. Sixty computers were purchased at \$400,000. Pending completion on testing, they will be used on all Shuttle missions starting with Mission 63 next March. (*AvWk*, Jan 3/95)

- NASA reported that three years of data collection from its Upper Atmosphere Research Satellite (UARS) confirmed that chlorofluorocarbons (CFCs) cause ozone loss. The satellite detected CFCs and hydrogen fluoride, a product of the chemical breakdown of CFCs, in the stratosphere. (*AvWk*, Jan 2/95; *The Grand Rapids Press*, Jan 2/95)

- A General Accounting Office report called NASA's plans to expand and fund the scientific research needed to support a manned space facility unrealistic. The report indicated that NASA's projected \$18 billion cost for Space Station Freedom was far too low. The chief congressional critic of the Space

Station, Senator William Cohen, estimated a \$71 billion price tag. (*AvWk*, Jan 2/95; *The Grand Rapids Press*, Jan 2/95)

January 6: During an occultation of the comet Chiron and a star, an airborne NASA observatory was used to help determine the size of this comet that orbits like a planet in a nearly circular orbit in our solar system. According to an international team of scientists, Chiron is between 103 and 193 miles in diameter and 20 times the size of Halley's comet. The Kuiper Airborne Observatory flew near Recife, Brazil, on this project. Chiron orbits the Sun once in 50 years. (*NY Times*, Jan 10/95; UPI, Jan 6/95)

- NASA's Space Station came under attack at a press conference by Senator Dale Bumpers (D-Ark) and several other Democratic senators. Bumpers introduced legislation in the Senate that would kill the Space Station program along with six defense projects. (*Htsvl Tms*, Jan 6/95)

- Several Senate Democrats proposed a \$33 billion package to balance the budget by the year 2002 by cutting defense and space programs. The package included elimination of NASA's Space Station for a savings of \$10 billion over five years. (*Fort Worth Star-Telegram*, Jan 6/95; *H Chron*, Jan 6/95, Jan 8/92; *Greensboro News & Record*, Jan 6/95; *News and Record*, Jan 6/95)

- Data collected from a NASA airborne observatory fitted with a 36-inch telescope helped astronomers estimate the size of the largest known comet, Chiron. This comet is between 100 and 187 miles in diameter, 20 times the size of Haley's comet. (*AP*, Jan 8/95)

- At a hearing of the House of Representatives Science Committee, NASA Administrator Daniel S. Goldin testified that NASA had experienced a 30 percent budget cut in the last two years but said he was prepared to oversee a "cleanup" of NASA management. He asked Congress not to ask for any more cost-saving redesigns of the space station. Goldin said the Agency was committed to change by functioning more efficiently with less money and by forming more partnerships with business to enhance the transfer of the latest technical information to industry. (*UPI*, Jan 6/95; *Gannet News Service*, Jan 6/95; *Federal News Service*, Jan 6/95; *H Chron*, Jan 7/95; *NY Times*, Jan 7/95; *W Post*, Jan 7/95; *APn*, Jan 6/95)

- After the successful launch of a satellite called "Wind," NASA gave the manufacturer, Martin Marietta Astro Space, the go-ahead to build a second satellite called "Polar." The purpose of both satellites is to measure the forces of solar wind. (*Star-Ledger*, Jan 6/95)

- An air-safety computer system developed by NASA at its Langley Research Center in Hampton, Virginia, in 1985 had yet to be approved by the Federal

Aviation Administration. The Takeoff Performance Monitor was designed to help pilots handle takeoff mishaps more quickly and safely, but airlines, manufacturers, and Federal Aviation Administration officials said the cost and liability burdens outweighed the benefits. Troublesome takeoffs occur less than 1 percent of the time but account for 10 percent of all serious airplane accidents, according to the National Transportation Safety Board. (CSM, Jan 6/95)

- NASA's Johnson Space Center denied Lockheed Engineering and Sciences Co. a large profit fee because of poor performance under a tougher procurement compliance policy implemented by the space agency in 1994. (*H Chron*, Jan 7/95)

January 8: A press report said that President Clinton was expected to meet with about 20 former admirals and generals to seek their advice on national security issues. Among those who were expected to attend was Vice Adm. Richard H. Truly, former head of NASA. (*AP* Jan 8/95)

- NASA expected to begin wind tunnel tests of its newest jet fighter, the X-32, in the summer of 1995. A lightweight, compact aircraft capable of maneuvering like a helicopter, the plane will employ the latest in stealth technology and will not need runway space for landings and takeoffs. Tests were to be conducted at NASA's Ames Research Center in Moffett Field, California. (NASA Release 95-4; *San Jose Mercury News*, Jan 8/95)

January 9: A large storm on Saturn was imaged by the Hubble Space Telescope on December 1, 1994. The storm, which was on Saturn's equator and the size of Earth, was white and in the shape of an arrowhead. It was only the third storm seen on Saturn in the past two centuries. (*AvWk*, Jan 9/95)

- The 1,700 lb., \$1.7 million robot Dante II, built by Carnegie Mellon University scientists, took gas samples and video pictures of the Spurr volcano in Alaska. The research is aimed at proving that cheap robots can be used on dangerous missions on Mars. (*Bus Wk*, Jan 9/95)

- NASA scientists expressed concern about space trash from spent satellites and burned out rocket boosters that pose a hazard to functioning satellites and space shuttles. Instead of attempting to collect such debris, NASA has been concentrating on preventing its further buildup by programming satellites and boosters to spiral into the atmosphere and burn up harmlessly. In the future, however, NASA may take a closer look at the possibility of retrieving space debris. At that point, the research of Kumar Ramohalli, formerly of NASA's Jet Propulsion Laboratory, who was attempting to develop a debris retrieving satellite, should be useful. (CSM, Jan 9/95)

- Two new images taken by NASA's Hubble Space Telescope provided details of the results of two violent cosmic events. One image shows a single star,

actually a planetary nebula in the constellation Draco, which blew off its outer shell 1,000 years ago and is in the last stages of its life. The other shows the result of a rare and spectacular head-on collision between two galaxies located 500 million light-years away in Sculptor. (NASA Release N95-1; *B Sun*, Jan 12/95)

- A space endurance record was set by Russian Cosmonaut Valeri Polyakov, who completed his 367th day aboard the Russian Space Station Mir. Polykov was launched into orbit January 8, 1994, and was expected to remain on Mir until March 22. (*Phillips Business Information*, Jan 9/95; *USA Today*, Jan 10/95; AP, Jan 10/95)

- A team of national geologists working with NASA scientists dropped a 700-pound weight on a jumbled mound of rock in Canyonlands National Park in Utah in an attempt to determine whether Upheaval Dome is a badly eroded salt dome or the remnants of a five-mile-diameter meteorite impact crater. Earlier studies of shattered rocks and quartz crystals had already convinced many researchers that an asteroid or comet fragment slammed into southeast Utah sometime between 5 and 100 million years ago. Impact craters such as Upheaval Dome are common in the solar system, so the geologists were attempting to learn how such craters form. (*Salt Lake City Tribune*, Jan 10/95)

January 10: Supercomputers helped scientists from the University of Arizona and the Los Alamos National Laboratory to understand the hidden mechanism by which massive stars explode. Computer simulations show that stellar explosions (supernovas) erupt unevenly from the collapsed stellar core. The trigger appears to be the energy of neutrinos, particles that have near zero mass and zero electrical charge. (*W Post*, Jan 10/95, *LA Times*, Jan 10/95)

- A senior scientist at the National Museum of Natural History, Kenneth M. Towe, refuted a recent satellite-based NASA claim that the presence of hydrogen fluoride in the atmosphere confirms that ozone depletion is largely caused by chlorofluorocarbons. Towe pointed out that, contrary to NASA's contention, hydrogen fluoride does have a natural source—it is emitted by volcanoes—and it plays a large role in the destruction of ozone in the lower stratosphere. Towe's position received corroboration from another authority, Michael S. Coffman, president of Environmental Perspectives, Inc., in Bangor, Maine. (*W Times*, Jan 10/95; *WSJ*, Jan 12/95; *Bangor Daily News*, Jan 11/95))

- Remote control technology and the Internet are expected to play major parts in the operation of the South Pole Infrared Explorer telescope and the Antarctic Submillimeter Telescope and Remote Observatory, both in Antarctica. These instruments were built and are operated by the Center for Astrophysical Research in Antarctica, a consortium of universities and

research laboratories supported mostly by the National Science Foundation. Astronomers will be able to control these instruments from any place in the world with an Internet or modem connection. (*NY Times*, Jan 10/95)

- Boris Ostroumov, deputy general director of the Russian space agency, said that the Baikonur Cosmodrome is a scientific and technical complex and that it will not become a Russian military base. The facilities will be used for scientific and national economic needs and will be administered by the Russian space agency, Ostroumov said. (*FBIS-Sov*, Jan 10/95)
- The claim of a new discovery by three NASA astronomers was refuted by a galaxy expert who was invited to their press conference. At a meeting of the American Astronomical Society in Tucson, Arizona, the astronomers claimed to have discovered six dwarf spiral galaxies, which they also claimed astronomers long thought existed but had never found. The Canadian galaxy expert claimed that dwarf spirals had been discovered by astronomers in the 1950s. (*AP*, Jan 11/95; *Reuter*, Jan 10/95)
- Industry analysis by the Virginia firm Teal Group showed that almost 1,000 satellites, mostly for communications, will be launched during the next 10 years. Most of these satellites will belong to mobile communications multi-satellite systems such as Motorola's Iridium and Space Systems/Loral's Globalstar. The most common destination for these satellites will be Earth low orbit. (*Defense Daily*, Jan 10/95)

January 11: After several attempts in 1994, Russian cosmonauts successfully tested the Mir Space Station's automatic docking equipment, clearing the way for the seven to ten scheduled dockings with American space shuttles through 1997. (*AP*, Jan 11/95; *H Chron*, Jan 12/95; *Dayton Daily News*, Jan 12/95; *C Trib*, Jan 12/95)

- Intelsat, the U.S. satellite operator, signed a record \$2 billion insurance contract for 10 satellite launches with the insurance firm International Space Brokers, Inc. The contract covered launches on the Ariane 4 rocket of the European Arianespace Consortium and on China's Long March rocket. (*Reuters*, Jan 11/95)
- Astronomers detected a gigantic mass, equivalent to 40 million Suns, in a distant galaxy that they believe to be a black hole. The discovery, announced at a meeting of the American Astronomical Society in Tucson, Arizona, was made by a team of American and Japanese scientists using a computer-linked system of 10 radio telescope dishes stretching from the Virgin Islands to Hawaii known as the Very Long Baseline Array. Since black holes, by definition, emit no visible light or other radiation, astronomers infer their presence by their strong gravitational pull on surrounding stars. The discovery was

made by observing the rotation of a disk of gas and dust surrounding a galactic nucleus. (*NY Times*, Jan 12/95; *W Times*, Jan 12/95; *W Post*, Jan 12/95, *AP*, Jan 12/95; *H Chron*, Jan 12/95; *CSM*, Jan 13/95)

- Two astronomers at the American Astronomical Society's annual meeting in Tucson, Arizona, presented an extraordinary photograph of a nearby star in red-hot death throes similar to the cataclysm that astronomers theorize will destroy the solar system in several billion years. The photo, taken with NASA's Hubble Space Telescope, showed never-before-seen detail in the glowing red gas cloud ejected by the dying star. The "Cat's Eye Nebula," or NGC 6543, is about 3,000 light-years from Earth in the constellation Draco, the dragon. (*B Sun*, Jan 12/95)

- Astronomers using the Hubble Space Telescope to study quasars began to reassess their theories after studying a series of quasars during the past few months. The astronomers expected the quasars, thought to be super-massive "black holes," to be surrounded by galaxies that "feed" the quasar. Instead, none of the first eight quasars they studied was surrounded by a galaxy, raising questions about how black holes form and sustain themselves. "I really don't understand this," said project astronomer John Bahcall in a report to the American Astronomical Society in Tucson, Arizona. (*LA Times*, Jan 13/95; *W Post*, Jan 13/95)

- Atmospheric scientists presented some 40 papers or abstracts at the fall meeting of the American Geophysical Union in Tucson, Arizona, on the topic of newly-discovered discharges of lightning in Earth's upper atmosphere. The upper-atmospheric lightning materializes above thunderheads and shoots upward, not downward, in bolts and flickers that soar as high as 60 miles above the surface of the Earth. Satellites have detected gamma ray bursts emanating from thunderheads, whereas red flashes have been linked to powerful burst of radio waves. NASA planned to fly a jet loaded with cameras and instruments across the thunderstorm belt of South America in February to begin serious study of upper atmospheric lightning. (*NY Times*, Jan 17/95; *H Chron*, Jan 23/95)

- NASA invited bids from the Nation's aerospace companies to develop two reusable rocket designs under a novel strategy that called for the industry to pay much of the cost. The goal was to enhance the competitive footing of U.S. companies in the lucrative global commercial launch market while lowering the amount spent annually by the federal government on space transportation.

NASA envisioned that the larger of the two vehicles would be capable of lofting 25,000 pounds of cargo or a human crew to the International Space Station as a replacement for the Space Shuttle. A gradual replacement of the shuttle might begin in 2005. The smaller vehicle would be designed for the

small volume, 1,000-to-2,000-pound satellites envisioned in the near future with new advances in electronics. The development of a new space transportation system is the first undertaken by NASA since it initiated the Shuttle program in the mid-1970s. (NASA Release 95-1; *H Chron*, Jan 14/95)

January 12: NASA requested proposals for two vehicles, X-33 and X-34, to prove the concept of single-stage to orbit. The X-33 would be a technology demonstrator vehicle and the X-34 would be a reusable, or partially-reusable, booster for placing small payloads into a low Earth orbit. Significant cost-sharing by industry was anticipated. (NASA Releases 95-1, 23, 38 & 40)

- NASA Administrator Daniel S. Goldin applauded Japan's contribution as a partner in the Space Station program when he spoke to high level science officials in Tokyo. Goldin was on his first trip to Japan as head of NASA. (*Phillips Business Information*, Jan. 16/95)

- NASA astronomers said that a stellar object that erupted last summer with powerful bursts of x-rays and jets of hot gas at near the speed of light may be a black hole or possibly a neutron star in the act of gobbling up a companion star. The object, a relatively close 10,000 light-years from Earth, was discovered in July when it exploded with flashes of the most powerful natural x-rays in the heavens. The radiation was detected by NASA's Compton Gamma Ray Observatory. (*AP*, Jan 12/95)

January 13: A contract for the design and development of the International Space Station was signed today by NASA and the Boeing Defense and Space Group, Missiles and Space Division. This 400-ton Space Station will be a catalyst for global cooperation, bringing together resources from the United States, Russia, Japan, member nations of the European Space Agency, Canada, and Italy. The new contract was for \$5.63 billion. Assembly will begin in November 1997 with the launch of the U.S.-purchased Russian FGB "space tug"—a power and propulsion module. It will be followed in December 1997 with Node 1, that will connect laboratory and crew modules and allow the Space Shuttle to dock. (NASA Releases 95-2 & 13; *Space News*, May 1/95; *AvWk*, Apr 10/95)

- The 1995 Astronaut Class, which begins in March, will include two international candidates. They are Japanese astronaut Takao Doi, Ph.D., and Canadian astronaut David S. Williams, M.D. Their selection as mission specialists brings the class size to 21. (NASA Release 95-3)

- Large-scale conceptual models of the X-32 Common Affordable Lightweight Fighter are scheduled to begin at the Ames Research Center this summer and continue through the summer of 1996. The idea for the X-32, which could be introduced into service around 2010, is to have two versions.

One would be a conventional take-off and landing aircraft. The second version would be much as the first, except configured for short take-offs and vertical landings. They would share a common fuselage and engine, while a powered-lift propulsion system would be used for vertical landings. (NASA Release 95-4)

- The Hubble Space Telescope's images of 14 bright quasars produce a giant leap backward in the scientific understanding of them. Current theory caused astronomers to expect each quasar to be surrounded by its host galaxy. However, most were alone in space. Scientists will have to rethink theories about what makes quasars shine. (*W Post*, Jan 13/95; *Science*, Jan 27/95 & Nov 24/95)

- NASA and Boeing Defense and Space Group of Houston, Texas, signed a \$5.63 billion contract for the design and development of the International Space Station. In particular, Boeing accepted responsibility for the design, manufacture, and delivery of the U.S. on-orbit segments of the station in a contract that extended through 2003. Assembly of the Space Station is projected to begin in November 1997; completion is foreseen in June 2002. (NASA Release 95-2; *H Chron*, Jan 14/95; *Phillips Business Information*, Jan 17/95; *AvWk*, Jan 23/95)

- Anatoly Kiselyov, General Director of the Khrunichev State Space Research and Industrial Center, said that NASA's terms for financing the work to develop and build the cargo module for the Alpha Station were unrealistic and that Russian air and space firms could not agree to them. Kiselyov said the real costs of building the functional cargo module would be 40 to 50 percent higher than American estimates, or at least \$220 million. The cargo module is to be the first component of a future space station and is scheduled for launch in November 1997. It will serve as the basis on which to build a future space complex. (*FBIS-Sov*, Jan 13/95)

January 16: A Japanese-German attempt to put a space capsule into orbit for five days of experiments failed, sending it tumbling through the atmosphere where it broke up and burned over the Pacific after two or three orbits. The \$60 million "Express" satellite was supposed to land in Australia's outback Saturday for retrieval. (*H Chron*, Jan 17/95; *Reuters*, Jan 16/95)

January 18: NASA announced that it planned a February 2 liftoff for the Shuttle Discovery, whose astronauts were to attempt the first rendezvous of a space shuttle with the Russian Space Station Mir. The planned eight-day flight was considered a rehearsal for a series of Shuttle-Mir docking missions set to begin in late May or early June. The STS-63 Mission was to be commanded by James D. Wetherbee, with Eileen M. Collins as pilot. (NASA Release, 95-5; *H Chron*, Jan 19/95; *AFP*, Jan 19/95; *APn*, Jan 18/95; NASA Note to Editors, N95-4)

January 19: An experimental X-31 aircraft crashed at Edwards Air Force Base in California. Its German military pilot ejected safely. The craft, one of two X-31's operated at NASA Dryden Flight Research Center, was returning from a one-hour test flight when it crashed. First flown in 1990, the aircraft had proven its ability to outmaneuver other fighters, particularly at low speeds. The cause of the crash was under investigation. (*Antelope Valley Press*, Jan 20/95; *H Chron*, Jan 20/95; *Daily News*, Jan 20/95; *APn*, Jan 19/95; *UPn*, Jan 19/95; *USA Today*, Jan 20/95; *W Post*, Jan 20/95; *C Trib*, Jan 20/95; *LA Daily News*, Jan 20/95; *LA Times*, Jan 20/95; *Bakersfield Californian*, Jan 20/95;)

- A Russian space enthusiast, Sergei Leskov, lamented the declining state of the Russian space program in the January 19 issue of "Izvestia." Production of rockets and other hardware has declined in the last few years, Leskov said, and even the hardware in orbit was on its last legs. The Mir Space Station, too, had grown old and increasingly gave mission controllers nasty surprises. He noted that during the past five years, funding of the space sector had been cut five-to-ten-fold in certain areas. The contract with the United States for construction of the Alpha space station had been the salvation of the Russian space sector, but only a small range of enterprises were involved in it, and the project did not promote development of new technologies. Without an infusion of more money, Leskov wrote, the Russian space sector could find itself as much a part of history as the Pyramid of Cheops. (*BBC Summary of World Broadcasts*, Jan 23/95).

- NASA Administrator Daniel S. Goldin said NASA intended to cut at least 2,500 civil servants from its payroll before the end of the century, scaling back its work force to levels not seen since the early 1960s. Supervisory positions at NASA Headquarters and its Field Centers were to be targeted as the Agency tried to stay in step with Clinton administration plans to shrink the government. (*H Chron*, Jan 20/95; *APn*, Jan 20/95; *W Times*, Jan 24/95; *AvWk*, Jan 23/95; *Fla Today*, Jan 22/95)

January 23: NASA and Russian space station officials were scheduled to begin a series of technical exchange meetings at the Johnson Space Center intended to give clear direction to joint cooperation in constructing the international space station. Twenty-five teams of Russian technicians and engineers were expected to arrive to discuss a number of issues, including docking procedures, power supply distribution, structural mechanics, depressurization, and place and use of antennae. Crew size was also to be discussed. The meetings were expected to last until February 10. NASA officials hoped to agree on as much common ground as possible so that Russia could be made an official partner in the station project before the year is out. (*Phillips Business Information*, Jan 19/95)

January 24: The *New York Times* reported that this month University of Illinois atmospheric scientists began aiming a powerful laser beam into the atmosphere

above the South Pole, expecting to illuminate many details about the depletion of the global ozone layer. The scientists hoped that the laser will help them create continuous three-dimensional maps of the chemical composition and physical details of the atmosphere throughout the year. (*NY Times*, Jan 24/95)

- According to an article in *Space News*, the fate of a proposed U.S. mission to Pluto rested on the ability of NASA engineers to cut the program's cost below the existing \$580 million estimate, presumably by incorporating high-risk technologies. U.S. scientists said time was running out for a Pluto mission. The planet is currently moving away from the Sun. Scientists predicted that by 2025, Pluto's atmosphere will be completely frozen for centuries, precluding any effort to view the planet's surface. The existing plan called for launching two probes in 2001 that would map the surfaces of Pluto and its Moon Charon before flying off into deep space. Cost-cutting measures being considered included reducing the amount of fuel for maneuvers at Pluto and the type of power source the craft will utilize for the mission. (*Space News*, Jan 23-29/95)

- An article in *Space News* noted that in the year since its dramatic repair, the once-ridiculed Hubble Space Telescope had opened a new window on the universe and established itself as one of the most important observatories ever built. Astronomers were full of praise for Hubble, which had finally lived up to its pre-launch hype. (*Space News*, Jan 23-29/95; *Fla Today*, Jan 22/95)

- Scientists at NASA's Jet Propulsion Laboratory in Pasadena, California, announced that the El Niño phenomenon had returned and was getting stronger. The TOPEX/Poseidon satellite, a program of NASA and the French space agency, Centre Nationale d'Etude Spatiales, provided radar data confirming the buildup of a large warm water mass called a Kelvin wave in the tropical Pacific Ocean. This high sea-surface temperature heats the atmosphere and alters atmospheric jet streams, which affect worldwide weather patterns. (NASA Release 95-7; *W Post*, Jan 25/95; *LA Times*, Jan 25/95; *AP*, Jan 24/95; *H Post*, Jan 25/95; *Reuters Press Agency*, Jan 24/95; *Bakersfield Californian*, Jan 25/95)

- A Russian booster rocket placed a U.S. commercial communications satellite into orbit for the first time. The FAISAT satellite was owned by Final Analysis, Inc., of Greenbelt, Maryland. (*H Chron*, Jan 25/95; *ITAR-TASS*, Jan 24/95)

- Russian cosmonauts aboard the Mir Space Station carried out geological studies of the Earth's surface and its mineral and petroleum resources. The three cosmonauts underwent physical examinations and were reported healthy. (*ITAR-TASS*, Jan 24/95)

January 25: A Chinese Long March 2E rocket carrying a telecommunications satellite exploded and crashed to Earth moments after launch, a setback to

space ambitions of China and major global broadcasters. The Apstar 2 satellite, built by Hughes Aircraft, would have provided television, telephone, and digital communications to a vast swath of Asia, Eastern Europe, North Africa, and Australia. (*W Post*, Jan 26/95; *USA Today*, Jan 26/95; *Xinhua News Agency*, Jan 26/95; *Reuters*, Jan 26/95; *AP*, Jan 25/95; *UPI*, Jan 25/95; *WSJ*, Jan 27/95; *LA Times*, Jan 27/95; *CSM*, Jan 27/95)

- Scientists at NASA's Dryden Flight Research Center at Edwards Air Force Base in California said that they had developed a \$14 million wing panel that would help them devise cheaper and more efficient ways to operate supersonic aircraft. The experimental panel was to be used in laminar airflow tests to search for ways to reduce aerodynamic drag and fuel consumption under NASA's High Speed Research program. Tests were scheduled on modified versions of the U.S. Air Force's F-16XL and Russia's TU-144 supersonic transport. (*Antelope Valley Press*, Jan/95; *Bakersfield Californian*, Jan 25/95; *Antelope Valley Daily News*, Jan 29/95)

January 27: Global warming resumed in 1994, after a two year lull caused by the mid-1991 eruption of Mount Pinatubo. Dr. James Hansen, head of NASA's Goddard Institute for Space Studies in New York, said he was more confident than ever there is a real warming that is a long-term trend. This warming was confirmed in several ways later in the year. If the effects of global warming raise sea levels an average of a foot and a half around the world, as some scientists predict, parts of many populated deltas would become uninhabitable. (*NY Times*, Jan 27/95, Feb 12/95, Sep 10/95, Sep 18/95 & Sep 26/95; *W Post*, Apr 25/95, Oct 25/95; *Fla Today*, Oct 1/95; *Science*, Feb 3/95, Apr 21/95, Jun 9/95, Jun 16/95, Sep 22/95, Nov 3/95 & Dec 8/95)

- NASA announced the crew members for the Shuttle Columbia STS-75 mission in early 1996. This flight was to be the second of the Tethered Satellite System (TSS) and also marked the third devoted to orbital investigations using the U.S. Microgravity Payload. Marine Lt. Col. Andrew M. Allen was named commander and Air Force Major Scott J. Horowitz, pilot. Joining them were: payload commander Franklin R. Chang-Diaz; Italian Space Agency TSS payload specialist Umberto Guidoni; mission specialist Jeffrey A. Hoffman, and European Space Agency mission specialists Claude Nicollier from Switzerland and Maurizio Cheli from Italy. (NASA Release 95-9; *H Post*, Jan 31/95)

January 29: NASA began a 110-hour countdown to the first of an unprecedented series of U.S. missions to the Russian Space Station Mir. Launch of Discovery and its crew of six—including the first woman Shuttle pilot and a famed cosmonaut—was set for February 2. The eight-day flight was to include a spacewalk by two astronauts, deployment and retrieval of an astronomy satellite, and science experiments in a commercial space laboratory. The primary

goal of the mission was to be the rendezvous with Mir. (*Reuters*, Jan 29/95; *APn*, Jan 29/95; *H Chron*, Jan 31/95; *H Post*, Jan 31/95; *H Chron*, Jan 29/95)

January 31: A testbed for a solar-powered regenerative fuel cell system was dedicated at Edwards Air Force Base. The Lewis Research Center's new government and industry multi-use regenerative fuel cell program mirrors the administration's policies of developing technologies that both foster U.S. competitiveness and support government programs. The Jet Propulsion Laboratory is an active member of the Lewis fuel cell team. Fuel cell applications include electric cars, buses, and locomotives in addition to less expensive means of power distribution for communities. (NASA Release 95-8)

- In experiments aimed at answering one of the most intriguing questions in particle physics and cosmology, scientists at Los Alamos National Laboratory in New Mexico produced especially strong evidence that elusive particles called neutrinos do indeed have mass. If proven, the finding means that neutrinos could constitute a major component of the mysterious invisible matter, the long-sought missing mass, that cosmologists think fills and shapes the universe and could dictate its fate. Finding a mass for the ubiquitous neutrino would help toward completing an inventory of the missing matter, a tally that will determine whether the universe will fly apart, fall in on itself, or settle on a middle path. D. Hywel White, leader of the research team, said that the most likely explanation for the observed behavior of neutrinos produced by a proton accelerator was that these particles have some as yet undetermined amount of mass. (*NY Times*, Jan 31/95)

- NASA officials dedicated a new testbed at Edwards Air Force Base in California's Mojave Desert for development of a solar-powered regenerative fuel cell system that they hope will one day provide clean and efficient renewable electric power. The testbed is the heart of Cleveland-based Lewis Research Center's new government and industry multi-use regenerative fuel cell program and mirrors the government's policy of developing technologies that will both foster U.S. competitiveness and, at the same time, support government programs. (NASA Release 95-8)

February

February 3: Launch of Space Shuttle Discovery (mission STS-63). On February 6 Discovery approached to within 37 feet of the Kristall module of the Russian Space Station Mir, where the two 100-ton spaceships flew in formation for a time. This rendezvous was a dress rehearsal for the first in a series of seven shuttle docking flights to Mir that would begin in June. This series, which will involve the Space Shuttle Atlantis, is intended to give the United States and Russia an unprecedented opportunity to combine flight operations, ground control, training activities, and research.

A spacewalk, in which Dr. Bernard Harris practiced lifting the 2,600-pound SPARTAN astronomy satellite before stowing it for the retransmission trip, helped prepare NASA for assembling the International Space Station. STS-63 was historic in several other respects. First, it was the first time that a woman pilot, Eileen M. Collins, flew the Space Shuttle. Second, it was the second time that a Russian, Vladimir Titov (who spent a record 365 days aboard Mir in 1987-88), was launched aboard a U.S. spacecraft. The shuttle flight ended with a predawn landing at Kennedy Space Center on February 11. (NASA Release 95-5; *NY Times*, Feb 4/95, Feb 5/95, Feb 6/95, Feb 7/95, Feb 8/95, Feb 10/95, Feb 11/95 & Feb 12/95; *W Post*, Jan 29/95, Feb 2/95, Feb 3/95, Feb 5/95, Feb 6/95, Feb 7/95, Feb 8/95, Feb 9/95, Feb 10/95 & Feb 12/95; *CSM*, Feb 8/95 & Feb 13/95; *Fla Today*, Jan 29/95; Reuters, Jan 31/95)

February 5: A protocol was signed for the Russian Functional Energy Block (FGB) to be launched in November 1997 as the first element of the International Space Station. After initial use as a propulsion module, the FGB will serve as a fuel storage module and a service area, which will provide living and experimentation space as well as backup guidance, navigation and control. The FGB will also serve as an integral part of the Space Station's overall power and information subsystems. (NASA Release 95-13)

February 7: Images from the international Space Radar Laboratory (SRL) may help researchers find previously unknown settlements near the ancient city of Angkor in Cambodia. The radar data was obtained during the October flight of the Space Shuttle Endeavour. SRL's complementary radars, the Spaceborne Imaging Radar-C/X-band Synthetic Aperture Radar (X-SAR), is a joint mission of the United States, German, and Italian space agencies. (NASA Release 95-12; *Space News*, Feb 27/95; *Science*, Feb 17/95)

February 9: Remotely controlled tests by Ames Research Center of a modified Russian planetary rover, Marsokhod, are planned for February 13-18 in a volcanic area that resembles the surfaces of the Moon and Mars. The test site is in Kilauea Volcano's summit caldera and southwest rift zone on the island of Hawaii.

Marsokhod, which combines the Russian rover chassis with western avionics, is a sophisticated prototype of a long-distance rover. (NASA Release 95-14)

February 20: A NASA white paper calls for the reorganization of its Field Centers, but doesn't foresee any closures. (*Space News*, Feb 20/95; *Science*, Feb 24/95)

February 23: Astronomers using the Hubble Space Telescope (HST) found an oxygen atmosphere on Jupiter's second Moon, Europa. This detection was made by a team of researchers at Johns Hopkins University and the Space Telescope Science Institute, both in Baltimore. They used data provided by HST's Goddard High Resolution Spectrograph (GHRS) instrument from observations taken on June 2, 1994. Europa's atmosphere is only one hundred billionth that of Earth. Europa, about the size of Earth's Moon, has an unusually smooth surface of solid water ice. The oxygen on Europa, whose surface temperature is -230 degrees Fahrenheit, is formed from purely non-biological processes. Water vapor and the gases oxygen and hydrogen are formed by the combination of sunlight and the bombardment of the dust and charged particles trapped in Jupiter's intense magnetic field. (NASA Release 95-17; *C Trib*, Feb 23/95)

February 26: Radioactive debris leaking from a large group of orbiting Russian nuclear reactors make up the puzzling clouds of junk orbiting Earth. This is the conclusion of a team of scientific sleuths who have been sifting clues for five years. The clouds, which seem destined to grow, are threatening to wreak havoc in the most crowded orbit in the heavens, roughly 600 miles up. In all, 33 nuclear-powered radar satellites that spied on the movements of Western warships were launched into orbits about 150 miles above the Earth. Afterward, as a safety precaution, Moscow boosted the old reactors into parking orbits roughly 600 miles up. Published designs of the Russian space reactors show they were filled with sodium-potassium coolant. Liquid droplets moving at kilometers a second are just as dangerous to a spacecraft as a solid object. While the drops pose no radioactive health danger to humans, they will force engineers to add more shielding to help protect new spacecraft. (*NY Times*, Feb 26/95)

February 27: NASA plans for a very active period soon concerning expendable launch vehicles (ELVs). An unspecified small ELV would operate from Wallops Island, Virginia. (*AvWk*, Feb 27/95)

February 28: Four more missions have been selected for NASA's Discovery program. Formally started in NASA's FY 1994 budget, it features small planetary exploration spacecraft with focused science goals that can be built in about 36 months for about \$150 million. Lunar Prospector was judged mature enough to proceed, while missions to study the Sun, Venus, and a comet

(Mission Stardust) were selected for further detailed study. Two missions are already under development in the Discovery program: the Near Earth Asteroid Rendezvous (NEAR) mission—which would orbit the asteroid Eros in 1999—and the Mars Pathfinder, which would land on Mars in 1997. (NASA Releases 95-19, 94, 112 & 209; *W Post*, Mar 2/95, May 15/95; *Fla Today*, Nov 5/95; AP, Mar 5/95 & Nov 27/95; *AvWk*, Mar 6/95 & Dec 11/95; *Science*, Mar 10/95)

- A non-invasive and direct method of measuring the bending stiffness of long bones was developed by the Ames Research Center, Stanford University, and Gait Scan Inc., of Ridge, New Jersey. The device is known as the Mechanical Response Tissue Analyzer (MRTA). NASA is interested in using it to test the bones of astronauts, who lose calcium from their bones during space flight. When a forearm or leg is rested on a stable support, a small probe is placed on the skin which transmits a “buzz” that lasts less than five seconds. This new technology has already been used to show the fragility of bones in patients diagnosed with brittle bones. The MRTA is also expected to be used for follow-up testing of patients with osteoporosis and for monitoring the healing of broken bones. (NASA Release 95-20)

March

March 1: NASA has collaborated with WGBH-TV, Boston, and Scholastic, Inc., New York, to produce an interactive videodisc "Interactive NOVA: Earth" that allows students to go on electronic field trips to remote areas to find clues of how life began on Earth. NASA's Offices of Mission to Planet Earth and Human Resources and Education contributed to this effort by providing data, visualizations, and other video resources as well as by actively participating in the current development through the involvement of key Agency researchers. (NASA Release 95-21)

March 2: Launch of Space Shuttle Endeavour (STS-67) on a 17-day mission. The mission included the use of three unique ultraviolet telescopes mounted on the Astro 2 observation platform. It built on the findings of Astro's first flight in December, 1990, when the Instrument Pointing System was balky. (NASA Release 95-18; *NY Times*, Mar 3/95, Mar 7/95, Mar 12/95 & Mar 13/95; *W Post*, Mar 3/95, Mar 7/95 & Mar 10/95; Reuters, Mar 5/95)

March 3: NASA's Infrared Telescope Facility observed the collision of Comet Shoemaker-Levy 9 with Jupiter from July 12 to August 7, 1994. The analysis of numerous observations were published in *Science*. All impacts warmed the stratosphere and some of the troposphere up to several degrees. (*H Chron*, May 14/95; *Science*, Mar 3/95)

March 6: A 94-percent scale model of Boeing's proposed Joint Advanced Strike Technology Fighter (JAST), now under construction, is planned to begin using the 80 by 120 foot wind tunnel at the Ames Research Center in early 1996. (*AvWk*, Mar 6/95)

March 8: NASA has selected four companies to enter into negotiations for the X-33 and X-34 reusable launch systems. Around the end of the decade, the results of the X-33 competition and subsequent flight demonstration could lead to a decision to develop an operational next-generation reusable launch system. The X-34 booster will demonstrate advanced technologies that may apply to reusable launch systems and provide significantly reduced mission costs for placing small payloads into low Earth orbit. The three X-33 selectees are: Lockheed Advanced Development Co.; McDonnell Douglas Aerospace; and Rockwell International Corp., Space Systems Division. The X-34 selectee is Orbital Sciences Corp., Dulles, Virginia. After tests are completed in 1999, it would be up to the aerospace industry to build and operate any new rockets. (NASA Release 95-23; *NY Times*, Mar 12/95 & Jun 19/95; *Fla Today*, Jul 2/95; *AvWk*, Mar 13/95, Mar 27/95 & Jun 19/95)

March 10: Several NASA-built components of the Infrared Telescope in Space (IRTS)—the first Japanese orbiting telescope dedicated to infrared astronomy—will be launched aboard Japan's Space Flyer Unit (SFU) on March 15 from Japan. U.S. scientists, in collaboration with Japanese colleagues, built two of the four IRTS instruments. One is the Mid-Infrared Spectrometer (MIRS), which will observe wavelengths between 5 and 12 microns. The two-pound MIRS will provide measurements "100-1000 times more sensitive" than before. The second component is the Far-Infrared Photometer (FIRP) which will image between 150 and 700 microns. The SFU is scheduled to be captured in-orbit by the Shuttle Endeavour during mission STS-72, scheduled for December 1995. After several days of systems checks, the SFU will be boosted by onboard rockets to a 500 km circular orbit. (NASA Release 95-24)

March 15: A team of aerospace executives has recommended that NASA modify the Space Shuttle program's management structure. The team was headed by former Johnson Space Center Director Christopher Kraft. The report to NASA Administrator Daniel S. Goldin recommends separating developmental activities from flight operations. The Kraft report endorses the themes of reducing the role of civil service employees, increasing contractor accountability, and reducing the number of government-to-contractor interfaces. (NASA Release 95-27; *NY Times*, May 22/95 & Apr 14/95; *W Post*, Jun 7/95; *Fla Today*, Mar 2/95 & Apr 5/95; Reuters, Mar 13/95; *AvWk*, Mar 6/95, Mar 20/95, Apr 10/95 & Jun 12/95)

March 16: A Soyuz TM-21 has launched the first U.S. astronaut to the Mir station. Astronaut Norman E. Thagard, M.D., lifted off from the Baikonur Cosmodrome in Kazakhstan on March 14, and the Soyuz docked with Mir on March 16. Thagard and the other Soyuz cosmonauts will spend three months on Mir, then return aboard Space Shuttle Atlantis. (NASA Release 95-25; *NY Times*, Mar 14/95, Mar 15/95 & Mar 17/95; *W Post*, Mar 14/95, Mar 15/95, Mar 17/95 & Apr 23/95; *USA Today*, Mar 14/95 & Jun 7/95; *Fla Today*, Apr 2/95 & Jun 7/95; *Space News*, May 1/95; Reuters, Mar 13/95; AP, Mar 13/95, Mar 3/14 & Apr 9/95; UPI, Mar 11/95; *AvWk*, Mar 20/95 & Apr 17/95)

- Global views of Venus from Magellan's imaging radar were released. They will be the basis for all future scientific studies of Venus and the maps for any future missions to Earth's sister planet. Magellan was launched May 4, 1989 and concluded last October after mapping more than 98 percent of the planet. Space radar findings also continue to contribute to a better understanding of Earth. (NASA Releases 95-28 & 201; *Science*, Dec 1/95)

March 19: In the midst of the budget wars in Washington, NASA and its ventures are under increasingly hostile fire. NASA has trimmed fat from dozens of programs and it is weighing whether to eliminate one of its dozen centers, which employ tens of thousands of people. The Agency is also investigating

ways to lighten the cost of lofting its fleet of four shuttles, which consume billions of dollars every year. Starting in 1996, there will be seven missions a year rather than eight. And last week, an independent advisory report suggested that NASA consider turning over Shuttle operations to a private contractor and cut back its safety checks. (*NY Times*, Mar 19/95; *W Post*, Mar 27/95, Mar 28/95, Mar 29/95 & Apr 7/95; *Fla Today*, Mar 14/95, Mar 28/95 & Apr 8/95; *Space News*, Mar 13/95, Mar 27/95, Apr 3/95, Apr 10/95 & Apr 24/95; Reuters, Aug 22/95; *WSJ*, Oct 2/95; *AvWk*, Feb 13/95 & Mar 27/95; *Science*, Mar 3/95, Mar 17/95, Apr 14/95 & Apr 21/95)

March 20: The Jet Propulsion Laboratory selected Lockheed Martin Astronautics to develop two small spacecraft that will explore Mars in 1998. They will be half the weight and cost of the 1996 Mars Global Surveyor and Mars Pathfinder. Their low weights of the new orbiter and lander will allow them to be launched on a new launch vehicle called the Med-Lite, which is being developed by McDonnell Douglas. (NASA Releases 95-30 & 196; *Space News*, Mar 27/95)

March 21: The Hubble Space Telescope serves as an interplanetary weather satellite for Mars and Venus. It shows that the Martian climate has changed since Viking visited Mars in the mid-1970s. The planet is now cooler, clearer, and drier. Venus continues to recover from an intense shower of sulfuric "acid rain" triggered by a suspected volcanic eruption in the late 1970s. Such knowledge of weather is critical to the planning of future missions to these planets. They also make natural laboratories for testing computer models that will lead to a general theory of the behavior of planetary atmospheres. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency (ESA). (NASA Release 95-31; *Fla Today*, May 14/95; *AvWk*, Mar 27/95; *Science*, Mar 31/95)

- NASA accepted a proposal from Johns Hopkins University to restructure the Agency's Far Ultraviolet Spectroscopic Explorer (FUSE). In addition to launching the spacecraft two years earlier than originally planned, the size, complexity, and cost of the program have also been reduced. The goal of the Explorer program restructuring was to enable funding for more frequent Medium Explorer (MIDEX) missions launched on a new medium-lite expendable launch vehicle. The FUSE mission was designed to study the origin and evolution of the lightest elements created shortly after the Big Bang, and the forces and processes involved in the evolution of galaxies, stars, and planetary systems. The far ultraviolet region of the spectrum can only be observed outside the Earth's atmosphere. (NASA Release 95-33; *Space News*, Aug 28/95)

March 22: The atmospheric probe on the Galileo orbiter passed all tests in its first communication in 27 months. After deploying the probe, Galileo will change its course to pass 133,000 miles above Jupiter's clouds. The orbiter will

collect the data from the probe and transmit it to Earth before it begins two years of operations near Jupiter. (NASA Release 95-34; *Fla Today*, Apr 10/95)

March 27: Astronaut Richard J. Hieb will leave NASA to join AlliedSignal Technical Services Corp.'s Civilian Space Business Enterprise as senior engineering advisor. (NASA Release 95-36)

March 31: A two-decade old cosmic mystery about hydrogen clouds in intergalactic space is being cleared up by recent Hubble Space Telescope data from 46 galaxies. The results suggest that the hydrogen clouds are vast halos surrounding galaxies and extending 20 times farther than the diameter of a galaxy. These findings confirm earlier Hubble data of more than a dozen hydrogen clouds within less than a billion light-years of our galaxy. (NASA Release 95-41; *NY Times*, Apr 18/95; *Science*, Mar 24/95)

April

April 3: NASA is working with industry to develop an air-launched, fly-back booster called the X-34. The U.S. hopes that a financially viable X-34 will return it to leadership in commercial space transportation. (*Fla Today*, Mar 31/95; *AvWk*, Apr 3/95)

April 4: Data from NASA's ER-2 and DC-8 aircraft show that climate computer models have significantly underestimated the amount of solar energy absorbed by clouds. The data were taken as the ER-2 flew at about 12 miles altitude while the DC-8 flew five to seven miles below it. The improved models will increase the accuracy of weather forecasting. (NASA Release 95-43; *Science*, Jan 27/95)

April 6: NASA has signed a contract with EER Systems Corp. of Vienna, Virginia to provide on-orbit and experiment recovery services during a mission from Wallops Island, Virginia this summer. Launch is expected to take place in late July 1995 aboard a Conestoga launch vehicle. (NASA Release 95-44; *Space News*, Jan 9/95 & Apr 17/95)

April 10: A Harrier V/STOL attack aircraft pilot will now be able to make "blind" landings on a 40 by 70 foot pad using Ames Research Center's new head-up display formats and flight control system. (*AvWk*, Apr 10/95)

April 12: Dr. T. Keith Glennan, the first chief of NASA, died at age 89. (*NY Times*, Apr 12, 1995; *W Post*, Apr 12/95; *Space News*, Apr 17/95)

April 19: The Chicago Fire Department has signed a Space Act agreement to explore ways space technology can be used to enhance emergency services. Candidate activities include: locating firefighters within a 2,400 foot area; monitoring the vibration signature of a burning structure to determine when the firefighters must be evacuated; checking into the feasibility of using liquid oxygen in a new breathing apparatus; identifying the location of an emergency 911 call made from a cellular phone; and warning hearing impaired drivers of an approaching emergency vehicle. (NASA Releases 95-51 & 116; *Space News*, Apr 24/95; *C Trib*, Apr 20/95)

- Hubble Space Telescope (HST) images of the asteroid, Vesta, indicate that this 325 mile diameter object has such features as ancient lava flows, impact craters, and an exposed mantle. This suggests that Vesta has survived essentially intact since the formation of the planets and could be the "sixth" terrestrial planet. (NASA Release 95-52)

- HST has discovered a new great dark spot in the Neptune's northern hemisphere. Only last June, Hubble images revealed that a great dark spot in the

southern hemisphere discovered by Voyager 2 in 1989 had disappeared. (In contrast, Jupiter's Great Red Spot has remained stable for 300 years.) While the energy from the Sun drives the Earth's weather system, the mechanism on Neptune must be very different because the planet radiates two times more energy than it receives from the Sun. (NASA Release 95-53; *W Post*, Apr 20/95; *Fla Today*, Jan 22/95; *AvWk*, Apr 24/95; *Science*, Jun 23/95)

April 21: Senior NASA managers have recommended that Ames Research Center be placed under the oversight of a private contractor. However, it also recommended that Ames' aerospace facilities be transferred to Langley Research Center and that its Space Station centrifuge be transferred to Johnson Space Center. The Zero Based Review Team also endorsed sweeping changes in the organization of NASA's other research facilities, but rejected a proposal to have a contractor run the Kennedy Space Center. (*SF Exam*, Feb 18/95; *Science*, Apr 21/95)

April 27: The Galileo spacecraft has produced hard evidence in the form of an image that asteroids can have satellites. The satellite in orbit around asteroid 243 Ida has a 1.6 km (one mile) diameter. (Reuters, Apr 26/95)

May

May 2: NASA halted construction of a rocket-motor nozzle factory at Yellow Creek, Mississippi, in favor of a duplicate capability in Utah. (NASA Release 95-60; *Fla Today*, May 3/95; *AvWk*, May 29/95)

May 12: A new generation of air traffic control tools are being field tested at the Denver International Airport. The Center-TRACON Automation System (CTAS) became its primary traffic management tool the day it opened on February 28. CTAS was designed with the involvement of the ultimate users, the controllers and the pilots. It consists of three software systems: the Descent Advisor (DA), an air/ground datalink system, and advanced cockpit automation. The DA has routinely met its goal of reducing arrival time prediction accuracy to under 20 seconds. In addition to reducing traffic controller workload, CTAS will increase aircraft fuel efficiency and reduce delays. The field tests are jointly conducted by NASA and the Federal Aviation Administration (FAA) which contemplate more such fruitful partnerships in the future. (NASA Releases 95-66, 198 & 150; *AvWk*, Jul 31/95, Aug 21/95 & Oct 30/95)

May 15: NASA tests a new noise reduction jet exhaust nozzle for a high speed civil transport (HSCT). The tests are being conducted at the Ames Research Center. (NASA Releases 95-69; *AvWk*, May 15/95)

May 16: NASA's telescope on its Kuiper Airborne Observatory has begun to examine the chemical composition of Mercury, which is the least understood of the four terrestrial planets-Earth, Mars, Venus, and Mercury. Flying at 41,000 feet, the specially outfitted C-141 military transport plane is able to detect invisible infrared radiation that is refracted and reflected by the planet's surface rocks. While nothing startling was discovered immediately about the planet's surface, weeks or months of analysis are likely to turn up new information about Mercury. (*NY Times*, May 16/95; *Fla Today*, Jul, 9/95)

May 19: An internal NASA review team has produced proposals that include sweeping management and organizational changes to cut spending an additional \$5 billion by the end of the decade. (NASA Releases 95-65, 73, 123 & 132; *NY Times*, May 20/95)

May 22: Today is the first of three dates that Earth will be able to view the rings of Saturn on edge in about 15 years. Thirteen of Saturn's 18 moons were discovered during past ring crossings. The other two dates in this trio will be August 10, 1995 and February 11, 1996. The Jet Propulsion Laboratory will use these opportunities to fine tune the mission of the Cassini spacecraft to be launched in 1997 for an examination of Saturn beginning in the year 2004.

(NASA Releases 95-72 & 118; *W Post*, May 3/95; *C Trib*, Apr 28/95; *AvWk*, Apr 24/95)

- The Hubble Space Telescope provided surprising findings about two extremely faint explosive white dwarfs, VW Hydri and U Geminorum, that have been known for about 30 years. Evidence shows that they are far cooler and spin much more slowly than expected. (NASA Release 95-75)

- NASA Administrator Daniel S. Goldin announced the Agency would cut 28,000 Civil Service positions, restructure each of its 10 centers, and turn over the operation of the Space Shuttle to a private industry. (*NY Times*, May 22/95; *W Post*, May 22/95)

May 23: The proposed U.S. Space Station Alpha is on schedule for operation by the year 2002. (Reuters, May 23/95)

May 26: A panel of the National Academy of Sciences asserts that the Gravity Probe-B is worth its cost. The controversial space experiment to test Einstein's general relativity theory is expected to cost a half billion dollars. (*LA Times*, Aug 31/95; *Space News*, Feb 20/95 & Sep 25/95; *Science*, Mar 24/95 & May 26/95)

- NASA Administrator Daniel S. Goldin hopes to create six Science Institutes run by universities or companies. Goldin says the institutes would not save money but he believes they would improve the quality of science in the Agency. (*Science*, Feb 24/95, Mar 17/95 & May 26/95)

- The Clementine 1 research satellite has shown that the bulk composition of the Moon has less iron than the Earth, suggesting a different origin. (*Fla Today*, Jul 2/95; *Science*, May 26/95 & Dec 8/95)

May 31: A converted DC-9 aircraft, which will be used for microgravity experiments, was rolled out today at NASA's Lewis Research Center. The aircraft will provide investigators with a series of 18-22 second periods of near weightlessness by flying parabolic maneuvers. It will support research in the areas of biotechnology, combustion science, fluid physics, and materials science. It also will support the development of equipment for use on the International Space Station and other orbital platforms. (NASA Release 95-79)

June

June 1: Woodpeckers riddled the insulating foam of the external fuel tank on top of the Space Shuttle Discovery, causing the Shuttle to be moved to a hangar for repairs. Its mission to launch a communications satellite is delayed until July. (*NY Times*, Jun 3/95 & Jul 13/95; *W Post*, Jun 1/95 & Jun 3/95; *USA Today*, Jun 2/95; *Fla Today*, Jun 3/95 & Jun 5/95; *Space News*, Jun 5/95; AP, Jun 2/95 & Jun 8/95; Reuters, Jun 1/95; UPI, Jun 1/95; *AvWk*, Jun 5/95 & Jun 12/95)

June 6: The final states of starbirth shown in new pictures by the Hubble Space Telescope, seem to touch off a cosmic celebration. Out of the dense whirlpools of gas and dust creating the stars erupt jets of shimmering gases extending billions of miles. The stars themselves, in machine-gun fashion, fire bursts of material at speeds of half a million miles an hour, creating what appear to be glowing beads. While many questions remain to be answered, the Hubble pictures appear to exclude whole classes of models regarding jet formation and evolution. (NASA Release 95-83; *NY Times*, Jun 7/95; *W Post*, Jun 7/95; *USA Today*, Jun 7/95; AP, Jun 7/95; Reuters, Jun 6 95; *Time*, Jun 16/95)

- Virtual-reality computers attached to gloves may assist astronauts training to perform maintenance in space. (CSM, Jun 6/95)

June 9: Mysterious red flashes that extend up to 55 miles above thunderstorms, called sprites, have been found over Peru. A NASA-sponsored investigation used special low-light-level cameras aboard a Westwind-2 jet aircraft to record the brief flashes. Fewer sprites were found in South America than were found over quickly moving storms in the central U.S. last summer. Sprites can be seen from the ground after dark under certain conditions. Blue jets were also documented in the U.S., although no blue jets were seen over South America. (NASA Release 95-84; *New Scientist*, Aug 19/95)

June 12: Astronomers using NASA's Astro-2 observatory announced the definitive detection of one of the two original building blocks of the universe—the element helium created in the Big Bang explosion. The evidence was found using the Hopkins Ultraviolet Telescope (HUT), one of three ultraviolet instruments on the Astro-2 observatory which was operated in the payload bay of the Space Shuttle Endeavour during its 17-day mission in March. Johns Hopkins University astronomers were able to detect the helium in the light from a distant quasar called HS1700+64, about 10 billion light years away. Essentially, the astronomers were looking at the universe when it was a quarter of its present age.

The HUT data also appear to give a partial answer to the puzzle of dark matter. Calculations based on HUT's data show that the primordial hydrogen and helium are about equal to the total amount of baryonic dark matter sci-

entists believe exists. (NASA Release 95-87; *W Post*, Apr 19/95; AP, Jun 12/95; *Time*, Mar 6/95; *AvWk*, Feb 27/95; *Science*, Jan 13/95)

June 14: The Hubble Space Telescope has detected a long-sought population of comets dwelling at the icy fringe of the solar system. Based on the Hubble observations, astronomers estimate the belt contains at least 200 million comets. The existence of a comet belt encircling our solar system-like the rings of Saturn-was first hypothesized more than 40 years ago by astronomer Gerard Kuiper. The theory remained conjecture until 1992 when ground-based telescopes began detecting about 20 large icy bodies ranging from 60 to 200 miles in diameter. Hubble was able to identify objects just a few miles across. This region is thought to be the source of the short-period comets that orbit the Sun in less than 200 years. The planet Pluto is considered by astronomers to be the largest member of the Kuiper Belt region. The comet-disk lies just beyond Neptune and might stretch 500 times farther from the Sun than Earth.

The Kuiper Belt is 100 times closer to Earth than the hypothesized Oort cloud, commonly thought to be a vast repository of comets tossed out of the early solar system. (NASA Release 95-88; *NY Times*, Jun 15/95; *W Post*, Jun 15/95; *Discover*, Nov 95; *AvWk*, Aug 7/95; *Science*, Jun 23/95)

- A new report on orbital debris has determined that the hazard to spacecraft posed by artificial debris, though still small, is growing and requires international action. Objects much smaller than those presently cataloged can destroy a spacecraft in a collision. Even collisions that do not destroy a spacecraft can degrade its performance or cause it to fail. The report was funded by NASA and conducted by a committee of the National Research Council. (NASA Release 95-88; *USA Today*, Jun 14/95; *Fla Today*, Aug 26/95)

June 19: The Maglifter introduced last year by NASA's Advanced Concepts Office is being developed by a nonprofit consortium that believes it can raise \$2 billion. A six month feasibility study will begin this summer, followed by a year-long prototype and demonstration. If successful, a for-profit corporation would complete the Maglifter facility and begin operations in 1999. (*AvWk*, Jun 19/95 & Oct 23/95)

June 20: NASA Administrator Daniel S. Goldin released a statement regarding the effects of the proposed five-year, \$2.7 billion reduction. He essentially stated that the House of Representatives' FY96 budget resolution assumes massive cuts in NASA's efforts to study the Earth. It would turn an integrated global program into a series of disconnected and fundamentally less effective measurements. The cuts would cripple the core of the program, the Earth Observing System. The U.S. government in partnership with scientists, private companies, and other nations must ensure that this cutting-edge research that is the foundation of Mission to Planet Earth is continued. While NASA is commit-

ted to prudent and permanent deficit reduction, further cuts to Mission to Planet Earth—and environmental research in general—seriously jeopardize an investment in the future that will return economic and quality of life benefits far in excess of what we spend today. (NASA Releases 95-54 & 99)

- The Jet Propulsion Laboratory has developed an Active Pixel Sensor which is virtually a camera on a chip. Using complementary metal-oxide semiconductor (CMOS) technology, it costs about three times less to make than a charge-coupled device (CCD) sensor. It is also less susceptible to radiation damage in space. It is under consideration by several major companies for licensing. (NASA Release 95-98; *Business Week*, Mar 6/95; *AvWk*, Jul 17/95)

June 23: Loss of a second Pegasus launch vehicle on June 22 has created a serious shortage of small launch vehicle support for NASA's scientific missions. NASA anticipates requesting industry to provide suggestions for alternate sources of small expendable and reusable services. Although the Agency would prefer to use U.S. vehicles, the White House could change the policy that precludes the use of others. (NASA Release 95-101; *Space News*, Jun 26/95 & Aug 28/95; *AvWk*, Jul 10/95 & Sep 4/95)

- The death of a laboratory rat while under anesthesia triggered a ten-week ban on animal research at the Ames Research Center. (*Fla Today*, Jul 30/95; AP, Jul 25/95; *Science*, Jun 23/95)

June 27: The launch of the Space Shuttle Atlantis (mission STS-71) and the first docking mission with Russian Space Station Mir occurred almost 20 years after the Apollo-Soyuz linkup in July 1975. The joined spacecraft had a record mass of about 200 tons and held a record 10 people—6 Americans and 4 Russians (8 men and 2 women). After five days of joint operations 245 miles above Earth, during which Mir's current crew underwent extensive medical testing in a shuttle cargo bay laboratory, the Mir-18 crew returned with Atlantis, having been replaced by two Russian cosmonauts.

American astronaut Dr. Norm Thagard, 52, who was aboard Mir since March 16th, also returned home with the American record for a single space flight after more than 115 days in space. (A Russian doctor holds the current world record—439 days.) In contrast to the cosmonaut crew, Norm elected to walk off of the Shuttle after returning to Earth. Atlantis landed at Kennedy Space Center on July 7. Six more trips by Atlantis to Mir are planned over the next few years. (NASA Releases 95-59 & 95; *NY Times*, Jun 29/95; Jun 30/95, Jul 1/95, Jul 4/95; Jul 5/95, Jul 8/95 & Jul 11/95; *W Post*, Jun 28/95, Jun 29/95, Jun 30/95, Jul 1/95, Jul 2/95, Jul 3/95, Jul 5/95 & Jul 8/95; *USA Today*, Jun 28/95, Jun 29/95, Jun 30/95, Jul 3/95 & Jul 5/95; *Fla Today*, Jun 28/95, Jun 29/95, Jul 1/95, Jul 2/95, Jul 3/95, Jul 4/95, Jul 5/95, Jul 7/95 & Jul 8/95; AP, Jun 27/95, Jul 6/95 & Jul 8/95; Reuters, Jun 27/95, Jul 1/95 & Jul 2/95; UPI, Jun 27/95; AP, Jul 2/95; *Newsweek*, Jul 10/95; *AvWk*, Jul 3/95)

June 28: Veteran Space Shuttle astronauts Kenneth S. Reightler, Jr., Richard N. (Dick) Richards and Pierre J. Thuot have left the Astronaut Office. Ken Reightler will join Lockheed Martin, Houston, as the program manager for Engineering, Test, and Analysis. Dick Richards remains at NASA, moving to the Space Shuttle Program Office to serve as the mission director for the second servicing mission for the Hubble Space Telescope. After three Shuttle flights, Thuot will teach astronautics courses at the Naval Academy. (NASA Release 95-104; *AvWk*, Jul 10/95)

June 29: NASA selected 30 research proposals for negotiation of Phase I contracts as part of the 1995 Small Business Technology Transfer Pilot Program (STTR), which is one of the ways that NASA takes the knowledge gained in air and space exploration and transfers it to the public. Companies that successfully complete Phase I activities are eligible to compete for Phase II awards the following year. The Phase II award allows for two-year, fixed-price contracts of up to \$500,000. (NASA Release 95-103)

July

July 7: The Delta 3 launch vehicle has a new second stage rocket engine planned for use in 1998. The new engine will be capable of generating 24,000 pounds of thrust. In combination with the larger solid-fueled boosters, the McDonnell Douglas Delta 3 will be able to carry twice the weight of the Delta into an orbit 22,300 miles above the surface of the Earth's equator. (*Fla Today*, Jul 7/95; *AvWk*, Sep 25/95)

- The turn-around maneuver critical to the vertical landing scheme for the X-33 reusable launch vehicle was demonstrated in a test flight. (NASA Releases 95-114 & 219; *Space News*, Jul 20/95, Oct 30/95 & Nov 6/95; *AvWk*, Jul 17/95, Sep 18/95 & Nov 13/95)

July 10: A report from the Office of Technology Assessment warns of shortcomings in U.S. space policy. It says that the efforts of NASA and the Defense Department to upgrade space launch technologies are not sufficiently coordinated and that some of efforts could undermine the goal of revitalizing the sector's global commercial effectiveness. (*AvWk*, Jul 10/95)

July 12: NASA is developing plans for the science institutes which are expected to help streamline the Agency's management structure and improve the quality of its scientific research. Two institutes are being defined as pathfinders. One is affiliated with NASA Johnson Space Center that would conduct biomedical research. The other is affiliated with NASA Ames Research Center that would focus on research related to the origins and evolution of life, and planetary biology. (NASA Releases 95-110 & 132; *Science*, Nov 17/95)

July 13: Launch of Space Shuttle Discovery (mission STS-70) marked the 100th human spaceflight. This event occurred 34 years after Alan Shepard's historic 15-minute sub-orbital flight into space. STS-70's primary objective was deployment of the Tracking and Data Relay Satellite-G. Discovery used a new version of a main engine which took a decade to develop. (NASA Releases 95-32, 59 & 71; *NY Times*, Jul 14/95; *W Post*, Jul 14/95; *USA Today*, Jul 14/95, Jul 17/95; *Fla Today*, Jul 11/95, Jul 12/95, Jul 16/95 & Jul 17/95; AP, Jul 12/95, Jul 13/95 & Jul 20/95; UPI, Jul 12/95 & Jul 21/95; Reuters, Jul 20/95 & Jul 21/95; *AvWk*, Jul 17/95)

- Galileo's atmospheric probe was successfully released after almost six years. The probe will achieve the highest impact speed (106,000 mph) of any human-made object on December 7 as it passes into Jupiter's atmosphere. (NASA Releases 95-108, 111 & 122; *NY Times*, Jul 11/95 & Jul 28/95; *W Post*, Jul 13/95, Jul 14/95 & Jul 28/95; *USA Today*, Jul 12/95; *Fla Today*, Jul 12/95,

Jul 13/95, Jul 14/95 & Jul 28/95; Reuters, Jul 13/95 & Jul 27/95; AP, Jul 12/95, Jul 13/95, Jul 25/95, Jul 27/95 & Aug 7/95; UPI, Jul 13/95; *Science*, Oct 27/95)

- Several wave motions of the Sun were detected by the Ulysses spacecraft. The measurement of an approximately five-minute wave and another about three-hours long were made by particle detectors. The shorter wave was confirmed by corresponding tones in the magnetic field data. Ulysses mission scientists have also found that the solar wind in the Sun's polar regions is nearly twice the velocity measured at lower solar latitudes. The Ulysses spacecraft was designed to study the regions above the Sun's poles. It is jointly managed by NASA and the European Space Agency (ESA). Ulysses will reach a maximum northern latitude on July 31. The spacecraft will then begin to journey out to the orbit of Jupiter, returning in September 2000 to the vicinity of the Sun, which will then be at the peak of the 11-year solar cycle. (NASA Releases 95-26, 96 & 109; *Fla Today*, Apr 2/95)

July 14: The Mars robot, which will land around July 4, 1997, will be named after "Sojourner Truth," who advocated the right for all people to be free. (NASA Release 95-112; *NY Times*, Jul 16/95; AP, Jul 14/95)

July 15: A new mission control center at the Johnson Space Center began operating about 10 hours after the launch of the Space Shuttle Discovery. It replaces the 30-year-old mission control which began controlling manned space flights in Houston rather than at Cape Canaveral, Florida. A network of 200 computer work stations are replacing the lumbering and inflexible, but highly reliable mainframe computer. Launchings and landings, the most dangerous parts of space flight, will be monitored from the original Mission Control at least through the end of the year to be sure there are no glitches with the new center. (*NY Times*, Jul 15/95; *W Post*, Jul 16/95; *Fla Today*, Feb 12/95 & 15/95; *Space News*, Dec 11/95; *H Chron*, Jul 9/95; AP, Jul 15/95; Reuters, Jul 14/95; *AvWk*, Jul 31/95)

July 19: Russian rocket engines will be offered by United Technologies for sale in the United States. United Technologies Corp.'s Pratt & Whitney unit agreed to market two of Energomash's rocket engines. The hope is that the engine will power the X-34 reusable rocket. (*Space News*, Jun 26/95; *WSJ*, Jul 19/95)

- NASA discovered singe marks in primary O-ring seals on both the Shuttle Discovery, launched July 13, and the Shuttle Atlantis, launched on June 27. The seals are in one of five nozzle joints in the Redesigned Solid Rocket Motor (RSRM) on the left boosters. Neither flight encountered problems. The investigation will delay the August launch of Space Shuttle Endeavour on mission STS-69. (NASA Release 95-130; *NY Times*, Jul 27/95 & Jul 29/95; *W Post*, Jul 28/95, Aug 7/95, Aug 12/95 & Aug 25/95; *USA Today*, Jul 24/95,

Jul 31/95 & Aug 14/95; *Fla Today*, Jul 19/95, Jul 28/95 & Aug 17/95; Reuters, Aug 25/95; AP, Jul 24/95, Jul 26/95, Jul 29/95 & Aug 18/95; UPI, Jul 26/95; *AvWk*, Jul 31/95, Aug 7/95, Aug 14/95 & Sep 18/95)

July 23: Two amateurs discovered comet "Hale-Bopp," which will pass near Earth in 1996. It could be the brightest comet in 20 years. Pictures from the Hubble Space Telescope show a remarkable pinwheel pattern and a blob of free-flying debris near the comet's nucleus. (NASA Release 95-178; *W Post*, Jul 31/95; *Fla Today*, Aug 27/95; *AvWk*, Oct 16/95)

July 24: "National Leadership/National Partnership" is NASA's theme at the Experimental Aircraft Association (EAA) Fly-In Convention and Sport Aviation Exhibition July 27-August 2 at Oshkosh, Wisconsin. A featured exhibit identifies unique partnerships formed between government, industry, and academia to revitalize the general aviation industry in areas ranging from modernizing cockpits to reducing aircraft weight and cost. Highlighted are activities of selected companies developing general aviation technology through the NASA Small Business Innovation Research (SBIRP) program. (NASA Releases 95-119, 128, 129 & 174)

- Hubble shows that the "faint blue galaxy" once thought to be rare is actually the most common type in the universe. At the faintest limits (i.e., several billion years ago) more than half of the galaxies seen are small irregular objects called "blue dwarfs." (NASA Release 95-120; *NY Times*, Apr 7/95; *W Post*, Aug 14/95)

- A solid-fuel booster for Ariane-5 was tested in French Guyana. The new rocket is designed to keep Western Europe's lead in launching heavy satellites into the next century. Arianespace has held the lead in world launch market share for many years since 1988. (*NY Times*, Apr 5/95; *Space News*, Jan 9/95; Reuters, Jul 24/95; *AvWk*, Apr 10/95, Jul 10/95, Aug 7/95, Sep 11/95 & Oct 2/95)

July 25: Supersonic Laminar Flow Control (SLFC) experiment may apply to High-Speed Civil Transport (HSCT) which could fly twice as fast as today's typical airliner. SLFC is a special structure mounted on the wing of an F-16XL. (NASA Releases 95-124 & 184; *Interavia*, Jan/95; *AvWk*, Oct 23/95)

July 27: President Bill Clinton presented astronaut Jim Lovell with the Space Medal of Honor, 25 years after he brought his crippled Apollo 13 spacecraft home. Actor Tom Hanks, who played Jim Lovell in the film "Apollo 13," was present at the ceremony. The President said that the "extraordinary mission" was made even more vivid by the recent "Apollo 13" film. (*W Post*, July 27/95; *W Times*, Jul 27/95; *USA Today*, Jul 27/95; AP, Jul 26/95 & Jul 27/95; Reuters, Jul 26/95; UPI, Jul 26/95)

July 28: During the edge-on view of Saturn's rings on May 22 by the Hubble Space Telescope, astronomers found what may be two new Moons. (NASA Release 95-127; *W Post*, May 3/95 & Jul 28/95; *USA Today*, Jul 28/95; *C Trib*, Apr 28/95; AP, Jul 28/95; *AvWk*, Apr 24/95 & Aug 7/95; *Science*, Aug 4/95)

July 30: Astronomers have confirmed the existence of a brown dwarf, the object of a 30-year search. Twenty to 50 times the size of Jupiter and too hot to be classified as a planet, GL229B is a small companion to the cool red star Gliese 229 in the constellation Lepus. It is near the theoretical limit (eight percent of the mass of the Sun) where a star has enough mass to sustain nuclear fusion. The brown dwarf was first sighted using the 60-inch observatory on Mt. Palomar. Scientists identified it in October 1994. Follow-up observations were made by Hubble's Wide Field Planetary Camera-2 on November 17, 1995. Another Hubble observation six months from now will yield an exact distance to GL229B.

The difference between planets and brown dwarfs is based on how they are formed. A planet is formed from dust while a brown dwarf would have gravitationally collapsed out of a large cloud of hydrogen. (NASA Release 95-212; *NY Times*, Sep 14/95; *Fla Today*, Jul 30/95 & Sep 24/95; *Newsweek*, Dec 11/95; *AvWk*, Dec 4/95; *Science*, Dec 1/95)

July 31: A prototype of the Cockpit Weather Information Needs (CWIN) concept developed by Langley Research Center is being installed on a United DC-10-10. It will be operated for at least three months on scheduled, revenue flights to evaluate the cost and safety benefits. Initially the weather data will be limited to a national radar summary and an air-to-ground lightning map. NASA has plans to add terminal forecasts and surface observations. (*AvWk*, Jul 31/95)

August

August 1: Ulysses has flown over both poles of the Sun in an unprecedented voyage giving insights into magnetic fields, solar winds, and cosmic rays. It reached its highest point on July 31. It passed over the south pole last September. The European Space Agency's (ESA) Ulysses spacecraft is the first to fly over both poles of the Sun. It will complete the northern polar pass on September 29 and begin to journey back out to the orbit of Jupiter. (NASA Release 95-125; *NY Times*, Aug 1/95; *Fla Today*, Sep 17/95; Reuters, Aug 8/95; *Science*, May 19/95 & Nov 10/95)

August 3: Rockwell and Lockheed are forming a joint venture called "United Space Alliance" as a contender for the Shuttle contract. Together these two companies have overall dominance in the Shuttle field. (*WSJ*, Aug 3/95; *Fla Today*, Aug 3/95 & Dec 1/95)

August 7: The Hubble Space Telescope (HST) shows that radio galaxies which—existed when the universe was half its present age—are surprisingly varied and intricate structures that are even more complex than previously thought. A team of astronomers at Cambridge University, England, is analyzing 28 radio galaxies that have been imaged by HST in visible light, by the Very Large Array Radio Interferometer, and by the UK Infrared Telescope. They propose that the remarkable structures seen in the Hubble images are different manifestations of activity associated with radio galaxies. The new details may be a combination of light from massive star forming regions, small satellite dwarf galaxies, and bow shocks caused by jets of hot gas blasted out of the galaxy's core by a suspected black hole. The period of strong radio emissions is quite short relative to the total lifetime of a galaxy. (NASA Release 95-133)

- The first NASA Starlink flight successfully bounced aircraft-based remote sensing data off a satellite for real-time delivery to an Earth station. It will allow NASA ground stations and remote nodes to monitor and process data from multiple, aircraft-based, high-altitude experiments in real time. The technology can also be used to assist response to major fires, floods, earthquakes, and hurricanes. (*AvWk*, Aug 7/95)

August 11: About 100 legally blind people are now seeing normally due to a product of NASA's Technology Transfer Program. The Low Vision Enhancement System (LVES), known as "Elvis" to its users, is worn on the head covering both eyes. Three frontal cameras send signals to a box where the images are processed for increased contrast. A black and white projector mounted over each ear feeds the images through optics which account for the user's eyeglass prescription. The headset and the hand-held control weigh about two pounds each. (NASA Release 95-136; *LA Times*, Jun 28/95)

August 14: Conestoga rockets are expected to be launched from Wallops Island, Virginia. These 52 foot rockets could bring life back to one of the earliest launch sites in the country. The rockets are produced by EER Systems to launch satellites for global communication and high-technology navigation. Today's launch was postponed due to hydraulic failure in two engines. (*W Post*, Aug 14/95 & Oct 11/95; *W Times*, July 20/95 & Aug 14/95; *Space News*, Jul 24/95 & Aug 28/95; *LA Times*, Oct 8/95; *AvWk*, Aug 28/95)

August 16: Lockheed Martin's new rocket malfunctioned as it was launched from Vandenberg AFB, California. The Lockheed Launch Vehicle (LLV-1) was designed to place payloads weighing up to one ton into low Earth orbit. (*USA Today*, Aug 16/95; *Fla Today*, Sep 3/95; *Space News*, Oct 2/95; *AP*, Aug 16/95; *AvWk*, Aug 14/95, Aug 21/95; Aug 28/95, Sep 4/95 & Dec 18/95)

August 18: Two-time Space Shuttle astronaut Dr. James P. Bagian has left the astronaut corps for a position with the Environmental Protection Agency's National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan. (NASA Release 95-142)

- Nobel laureate Samuel Ting of MIT hopes that the Space Shuttle will carry a Chinese-built magnet for the detection of antimatter in 1998. If it performs successfully, it may gain a place aboard the Space Station in 2001. However, the White House has warned NASA to avoid initiating joint projects with China. (*Science*, Aug 18/95)

August 21: NASA expects to select a single prime contractor for its Space Shuttle program within a year and turnover Shuttle operations in 1998. (*W Post*, Aug 22/95; *USA Today*, Aug 22/95; *Space News*, Aug 28/95; *WSJ*, Aug 22/95; *AP*, Aug 21/95; *UPI*, Aug 21/95; *AvWk*, Aug 28/95)

August 23: U.S. polar orbiting weather satellite programs are being combined to save money. Costs for the combined program will be split between the National Oceanic and Atmospheric Administration and the Defense Department. NASA will be in charge of developing the technology for the new systems. (*AP*, Aug 23/95)

August 28: The Cassini spacecraft is being tested in preparation for integration of its major systems next year. The mission is scheduled to launch in October, 1997 with the spacecraft's arrival at Saturn in 2004. (NASA Release 95-118; *AvWk*, Aug 28/95)

August 29: A natural laser in space was detected coming from a young, very hot, luminous star in the constellation Cygnus. The laser was created as intense ultraviolet light from the star excites the densely packed hydrogen atoms in the gaseous, dusty disk surrounding the star. When infrared light

shines on the excited hydrogen atoms, it causes the atoms to emit an intense beam of light at exactly the same wavelength, creating the circumstellar laser. This natural laser was detected on NASA's Kuiper Airborne Observatory (KAO) during missions based on Hawaii. The existence of such natural lasers was predicted more than 15 years ago. (NASA Release 95-148; Reuters, Aug 29/95; *Fla Today*, Sep 10/95; *Science*, Sep 8/95)

- The Galileo spacecraft is plowing through the most intense interplanetary dust storm ever measured. This is the greatest of several large dust storms encountered since December 1994, when the spacecraft was still almost 110 million miles from Jupiter. (NASA Releases 95-147; *NY Times*, Sep 3/95; *USA Today*, Aug 31/95; *Fla Today*, Aug 31/95; *Space News*, Sep 4/95; AP, Aug 29/95 & Aug 31/95; *AvWk*, Sep 11/95)

- TOPEX/Poseidon, the U.S./French ocean-observing satellite, has completed its three-year mission. Fortunately, the health of the satellite leads its managers to expect it to continue operating another four years. The Jet Propulsion Laboratory manages the U.S. portion of the mission for NASA's Office of Mission to Planet Earth. The satellite has detected the oceans to have risen more than a tenth of an inch in each of the past two years. However, it may be too soon to tell whether the rise seen by the TOPEX/Poseidon ocean observing satellite will continue. (NASA Release 95-146; AP, May 4/95; UPI, May 4/95; *Fla Today*, Jun 25/95; *Space News*, Sep 4/95; *Science*, May 5/95)

- The American Association for the Advancement of Science (AAAS) warns that "the long term effects of dismantling a coherent scientific enterprise could be very harmful." (*NY Times*, Aug 29/95; *W Post*, Aug 29/95)

- Seven U.S. rockets will be launched into space from Australia. Five U.S. universities will be watching the launches very closely. The payloads will be launched aboard Black Brandt IX rockets. (NASA Release 95-187; *Space News*, Nov 27/95; AP, Aug 29/95)

September

September 1: NASA is shifting its plans for the multibillion-dollar Earth Observing System (EOS) away from long-term global change toward acquiring information more immediately useful to such groups as farmers and the fishing industry. A panel convened by the National Academy of Sciences endorses EOS while making several suggestions. (NASA Release 95-65; *Space News*, Oct 9/95; *Science*, Apr 21/95, Sep 1/95 & Sep 22/95)

September 4: The first element of the International Space Station Alpha will be the Functional Cargo Block (FCB). It is actually a 21-ton "space tug" being built in Russia and set for launch in November 1997. The U.S. Boeing Defense and Space Group has teamed with Russia's Khrunichev Space Center on this project. Boeing will procure one block for launching. (*Fla Today*, Aug 18/95; Reuters, Aug 15/95; *Space News*, Dec 18/95; *AvWk*, May 8/95 & Sep 4/95)

September 7: The Space Shuttle Endeavour (STS-69) was launched to deploy and retrieve two scientific spacecraft. One was the second flight of the Wake Shield Facility-2, a 12-foot diameter disk for growing semiconductor films. The other was the SPARTAN 201 on its third flight. Its mission was to study the outer atmosphere of the Sun and its transition into the solar wind that constantly flows past the Earth. (NASA Releases 95-121 & 164; *NY Times*, Sep 3/95, Sep 14/95, Sep 15/95, Sep 16/95, Sep 17/95, Sep 18/95 & Sep 19/95; *W Post*, Sep 8/95, Sep 11/95, Sep 12/95, Sep 17/95, Sep 18/95 & Sep 19/95; *USA Today*, Sep 11/95 & Sep 13/95; *Fla Today*, Sep 11/95, Sep 12/95, Sep 14/95 & Sep 17/95; CSM, Sep 11/95; AP, Sep 7/95, Sep 8/95, Sep 10/95, Sep 12/95, Sep 15/95 & Sep 18/95; Reuters, Sep 9/95, Sep 11/95 & Sep 14/95; UPI, Sep 7/95; *AvWk*, Sep 11/95 & Sep 18/95)

September 11: A 600 pound, solar power aircraft named Pathfinder set a new altitude record of 50,500 feet. The remotely-controlled vehicle is being evaluated by NASA and industry for environmental sampling missions. (NASA Release 95-152; *AvWk*, Sep 18/95 & Sep 25/95)

- NASA engineers are investigating technologies to be used on an inexpensive "lifeboat," X-35, for the International Space Station's crew. (*AvWk*, Sep 11/95 & Dec 18/95)
- NASA managers have drawn up plans to furlough up to 92 percent of the Agency's 21,500-member workforce if the Federal government runs out of money on October 1. (*Space News*, Sep 11/95)
- Last month, the Russians declared their own version of bankruptcy by confiscating Rimsat's investment. The deal between an American company and

Informcosmos had several Gorizont satellites in orbit in 1994, providing television and cellular networks in Asia. At issue is who owns the satellites. (*Space News*, Dec 11/95; *WSJ*, Sep 11/95)

September 18: Childbirth is expected to be made safer and easier with the space-age forceps being developed by Marshall Space Flight Center with the Collins Clinic in Slidell, Louisiana. Using space program instrumentation technology, fiber optic sensors in the forceps will enable the physician to monitor forces on the infant throughout the delivery. The use of composite materials will help ensure a safer distribution of pressure on the infant. Additionally, the instrumented forceps will allow obstetrical students to learn to use forceps within safe limits before entering practice. (NASA Release 95-153)

September 19: An early goal of NASA's proposed New Millennium program is to test highly sophisticated space hardware to prove that scientific spacecraft can be built more than 30 percent smaller without sacrificing performance. The first New Millennium spacecraft will explore a comet, an asteroid, or some combination of them. Three deep space missions are to be flown by the year 2000. (NASA Releases 95-100 & 155; *Space News*, Feb 13/95, Jun 5/95 & Sep 4/95; *AvWk*, May 15/95 & Sep 25/95)

September 22: Predictions of El Niño can now be made more than a year in advance due to computer models that now incorporate ocean data. (NASA Release 95-159; *USA Today*, Oct 26/95; *Fla Today*, Nov 26/95; *Science*, Sep 22/95)

September 25: TRW received a contract to build two more Earth Orbiting System (EOS) spacecraft. EOS is the centerpiece of NASA's Mission to Planet Earth, a long-term effort to study global climate changes. (*Space News*, Oct 9/95; *AvWk*, Sep 25/95)

- NASA's Optical Transient Detector (OTD) has found a relationship between intense satellite-observed lightning activity and tornado formation. Launched April 3 aboard a Pegasus rocket, the OTD observed a peak of 60 flashes per second a minute before a tornado was seen touching the ground. (NASA Release 95-160; *Space News*, Oct 30/95)

- Microcosm Inc. is developing a rocket engine that would be the basis of a "Scorpius" family of low-cost launch vehicles. It estimates that its "Liberty" version would cost one-tenth the price of the Lockheed Launch Vehicle (LLV). Liberty involves four stages, seven propulsion pods, and 49 engines. The work started with a Small Business Innovative Research (SBIR) contract from the Ballistic Missile Defense Organization in 1993. NASA is deciding whether to fund several SBIR contracts for a one-engine "SR-S" rocket. (*AvWk*, Sep 25/95)

September 29: To insure that new and far-reaching concepts continue to be identified, NASA has initiated a program called Advanced Concepts Research Projects. It intends to fund eight ACRP fellows in 1996. (NASA Release 95-165; *Space News*, Oct 9/95; *AvWk*, Oct 16/95)

- Pioneer 11 is scheduled to end operations after an epic career. Although launched a year before Pioneer 11, Pioneer 10 inexplicably has a stronger power supply and should function for another three or four years. (NASA Release 95-163; AP, May 15/95)

October

October 5: Saturn's possible two new moons sighted by the Hubble Space Telescope (HST) on May 22 are thought instead to be orbiting clumps of icy rubble. Images from the August 10 "ring plane crossing" presented a new mystery. They seem to show at least three new objects, which are in different orbits than the two May objects. An explanation is that a shattered moonlet would be brighter and more visible, than when all of its mass was compressed into a single solid body. (NASA Releases 95-172; *Science*, Oct 20/95)

- In 2004, the asteroid Toutatis will pass by Earth at a range of four times the distance between the Earth and the Moon. Unlike the rotations of hundreds of asteroids that have been studied with optical telescope, Toutatis has neither a simple rotation nor a fixed pole, according to two NASA-sponsored scientists. The asteroid is 2.9 miles by 1.5 miles by 1.2 miles. No known asteroid or comet will approach Earth as close as Toutatis until the year 2060. (NASA Release 95-171; *Science*, Oct 6/95)

October 6: A panel of industry managers and academic researchers recommends improvements in the way NASA conducts scientific research. It recommends that the Agency give its chief scientist more authority, develop realistic priorities to match a slowly declining budget, combat the "insular culture" at NASA Centers and subject technology to more exacting peer review. (*Space News*, Oct 9/95; *Science*, Oct 6/95)

October 7: A robot alfalfa harvester is a joint project of Carnegie Mellon, NASA, and the New Holland farm equipment company. Although America lost the robot wars in the last few decades, many new applications are now seen. (*NY Times*, Oct 7/95; *AvWk*, Jun 26/95)

October 10: NASA is flight testing an aircraft with controlled nose strakes that promises increased maneuverability and agility in air combat situations. The strake project, called Actuated Nose Strakes for Enhanced Rolling (ANSER), consists of two moveable "flipper-like" panels called strakes installed on the upper nose of an F-18 aircraft. The hinged four-foot long, six-inch wide panels will assist the pilot in yawing to the right or left at high angles of attack when conventional rudders lose their effectiveness. (NASA Release 95-175; *Antelope Valley Press*, Oct 18/95; *AvWk*, Nov 20/95)

October 16: The HST has discovered ozone on Jupiter's satellite Ganymede, making it one of the solar system's rare moons that have atmospheres. Ganymede's ozone is produced when it passes through charged particles trapped in Jupiter's powerful magnetic field. (*AvWk*, Oct 16/95)

HST has also imaged bright auroras of Saturn's northern and southern poles in far ultraviolet light. The circular band centered on the north pole is an enormous auroral curtain rising as far as 1,200 miles above the cloudtops. This curtain changed rapidly over the two hour period of Hubble observations. The aurora is produced as trapped charged particles collide with atmospheric gases-molecular and atomic hydrogen in Saturn's case. (*AvWk*, Oct 16/95; *Science*, Aug 18/95)

October 18: NASA physicists have assembled the first view of the spiral structure of our solar system's magnetic field. The aerial photo of the interplanetary magnetic field became possible as Ulysses flew over the south pole of the Sun in 1994. The method involved tracking the bright spots of radio waves excited by moving electrons ejected from the Sun at speeds over 62,100 miles per second. Such spots are caused by solar flares or other explosive events on the Sun. The travel of electrons is constrained to the large-scale magnetic field lines, much as cars follow roads. A chart of the received radio emissions shows they follow the expected spiral shape, even including kinks due to variations in solar wind speed. At these high speeds, the whole path takes about 20 minutes to Earth's orbit. (NASA Release 95-185; *W Post*, Oct 23/95)

October 20: Space Shuttle Columbia (STS-73) is launched. During the mission Columbia provided a calm, stable platform for 16 days of on-orbit research using the Microgravity Laboratory (USML-2) Spacelab that consisted of over 40 fluid-physics, material science, and biotechnology experiments. Columbia landed on November 5. Columbia's window was nicked by space debris. The Space Shuttle also received a 1 cm crater in its cargo bay door, the biggest impact to date. (NASA Release 95-152; *NY Times*, Oct 21/95, Oct 22/95, Oct 27/95 & Nov 5/95; *W Post*, Oct 29/95 & Nov 6/95; *Fla Today*, Oct 27/95, Nov 3/95 & Nov 4/95; *USA Today*, Nov 6/95; *Space News*, Nov 6/95 & Dec 4/95; *AvWk*, Nov 13/95)

October 23: A Conestoga rocket exploded 45 seconds after liftoff from NASA's Wallops Island, Virginia. Built by EER Systems Corp., the rocket was ending its first stage when it blew up. (*NY Times*, Oct 24/95; *W Post*, Oct 25/95; *W Times*, Oct 25/95; *USA Today*, Oct 24/95; *Space News*, Oct 9/95, Oct 30/95 & Dec 11/95; *AvWk*, Oct 30/95)

- Astronauts Wendy Lawrence and Scott Parazynski were rejected as candidates to fly onboard Soyuz due to height requirements. Scott was too tall and Wendy was too short. (NASA Releases 95-156 & 191; *W Times*, Oct 18/95 & Oct 30/95; *USA Today*, Oct 16/95; AP, Nov 9/95; *AvWk*, Oct 23/95)

October 26: Galileo's tape recorder, which had been balky, is again working. Scientists will avoid using the magnetic tape near either end of the reel to reduce the power needed to operate the recorder. (NASA Releases 95-168,

182, 188 & 193; *NY Times*, Oct 21/95; *W Post*, Oct 13/95, Oct 23/95 & Oct 29/95; *Fla Today*, Nov 5/95; *Space News*, Oct 16/95, Oct 23/95, Oct 30/95 & Dec 11/95; *AvWk*, Oct 23/95, & Oct 30/95; *Science*, Oct 27/95)

October 27: An historic wind tunnel at NASA Langley Research Center, Hampton, Virginia is being retired. Originally called the "Full Scale Tunnel" when built in 1931, it was the largest wind tunnel in the world until 1945. (NASA Release 95-194; *AvWk*, Nov 20/95)

November

November 2: The Hubble Space Telescope has provided pictures of a special type of newborn star emerging from dense, compact pockets of interstellar gas called evaporating gaseous globules (EGGs). Hubble found the EGGs, appropriately enough, in the Eagle nebula which is a star-forming region of the nearby constellation Serpens. Many EGGs are found at the tip of the two largest finger-like features protruding from the nebula's monstrous columns of cold gas, dubbed "elephant trunks." Photos of EGGs at different stages of being uncovered provide an unprecedented look at how stars and their surroundings appear before they are truly stars. This process of forming stars from high-speed columns of hydrogen is quite different from the process of stars forming in isolation. The EGGs appear unable to form the disks that go on to become solar systems. (NASA Release 95-190; *NY Times*, Nov 3/95; *W Post*, Nov 3/95; *W Times*, Nov 3/95; *USA Today*, Nov/95; *Fla Today*, Nov 3/95; AP, Nov 3/95; *Newsweek*, Nov 13/95)

November 6: NASA's unmanned spacecraft Wind, patrolling interplanetary space 662,000 miles from Earth, detected a "giant magnetic cloud" on October 18. An updated "space weather alert" was issued to commercial satellite operators, electrical utilities and other organizations worldwide. The disturbance was speeding to Earth at over 2.1 million miles per hour. It produced a magnetic storm and auroral displays that persisted for two days. Future disturbances are anticipated as the 11-year sunspot cycle is expected to peak shortly after the year 2000. The Wind spacecraft was launched November 1, 1994. (NASA Release 95-202; *Space News*, Oct 30/95)

- NASA suspended the X-34 program for two weeks on November 2 over the issue of whether a U.S. or a Russian engine would be used. The next day White House officials denied NASA's request to withdraw from the government-industry team building the unmanned reusable launcher. (*Space News*, Nov 6/95; *AvWk*, Nov 6/95)

- Lockheed Martin plans to develop an advanced Atlas rocket to launch large commercial satellites. The "IIAR" would be ready to launch medium-lift to intermediate-lift payloads in December, 1998. This new rocket is a challenge to Arianespace, the 53-member European space consortium, and to the McDonnell Douglas Corp. (*WSJ*, Nov 6/95)

- Boeing Co. is developing a venture to use converted oil-drilling platforms to launch satellites atop Zenit rockets, which are built by NPO Yuzhnoye of the Ukraine. The plan would allow as many as 22 launches through 2001, as long as world demand for launches to geosynchronous orbits remains strong. (*Space News*, Dec 11/95; *WSJ*, Nov 6/95 & Dec 6/95)

November 7: A satellite payload designed and built by college students was launched onboard a NASA launch vehicle. Shortly after launch the SURFSat-1 was separated from the primary payload and moved into a polar orbit. When the project began in 1987, six Caltech students were chosen to begin the Summer Undergraduate Research Fellowship (SURFSat). Each summer a new group of undergraduates took over. Through 1994, 61 students have participated. The satellite has two experiments: one tests how Earth's atmosphere affects the new Ka-band being implemented on NASA's Deep Space Network, and the other tests ground stations supporting NASA's new Space Very Long Baseline Interferometry project. The latter will be used to communicate with a Japanese spacecraft that will make radio astronomy studies of quasars and other objects at the edge of the universe. (NASA Release 95-204; *Space News*, Sep 4/95 & Nov 13/95)

- NASA will pursue a non-competitive contract with United Space Alliance to assume responsibility eventually for Space Shuttle operations. Rockwell International and Lockheed Martin Corporation, together holding 69 percent of the dollar value of all Shuttle related prime contracts, formed the joint venture, "United Space Alliance." The non-competitive contract was clearly in the public interest as no other company could possibly meet NASA's safety, manifest and schedule requirements. (NASA Releases 95-158 & 205; *W Post*, Nov 8/95; *WSJ*, Nov 8/95; *Fla Today*, Nov 8/95 & Dec 6/95; *Space News*, Dec 4/95; *AP*, Aug 3/95; *AvWk*, Nov 13/95)

November 12: Space Shuttle Atlantis (STS-74) is launched. On its second visit to Space Shuttle Mir, Atlantis added a permanent Russian-built docking port. The 15-foot, 9,000 pound docking tunnel came with two new solar arrays, one built in Russia and one provided by NASA, that would be assembled later. The link up, which occurred on November 15, required the pilot, Kenneth Cameron, to aim for a target about three inches in diameter and connect at a speed of less than one-tenth of a mile per hour. The quarter-million-pound spacecraft docked with Mir, of about the same weight, as they sped through space at 17,500 mph. They remained docked for three days. Mission STS-74 ended on November 20, paving the way toward assembly of the International Space Station beginning in November 1997.

The show went on despite a possible Government shutdown. Mission control jokingly told the five astronauts, "We expect you to show up for work, furlough or not." (NASA Release 95-192; *NY Times*, Nov 13/95, Nov 15/95, Nov 16/95, Nov 19/95 & Nov 21/95; *W Post*, Nov 13/95, Nov 14/95, Nov 15/95, Nov 16/95, Nov 19/95 & Nov 21/95; *USA Today*, Nov 13/95, Nov 14/95 & Nov 20/95; *Fla Today*, Nov 14/95 & Nov 23/95)

November 13: The Far Ultraviolet Spectroscopic Explorer (FUSE) mission will be launched in October 1998. This mission was selected earlier in the year as part of an overall restructuring of the Explorer program. Beginning in 1958, the

Explorer program provides Earth-orbiting satellites to conduct research in space physics and astrophysics. (NASA Release 95-206; *Space News*, Nov 27/95)

November 15: A temporary government shutdown is being considered. Although the Space Shuttle would remain in orbit, NASA TV—the entity that provides footage of the astronauts during the mission—could be closed. (CSM, Nov 15/95)

November 17: NASA plans to create independent institutes that would take over much of the research now being performed at five NASA centers. However, many scientists fear that the reforms were hastily conceived and could shortchange NASA research. (*Science*, Nov 17/95)

November 20: Two large aerospace contractors, Boeing Co. and McDonnell Douglas Corp., are investigating their merger potential. (*WSJ*, Nov 20/95)

November 21: An international team of scientists have examined data from the Japanese/U.S. X-ray astronomical satellite “ASCA” which may confirm how cosmic rays achieve speeds near the speed of light. Enrico Fermi suggested a theory in 1949 in which charged particles are bounced between turbulent regions inside the shock front of a supernova explosion. Bouncing much like a ping pong ball between a table and a paddle as the paddle is brought closer to the table, a charged particle gains energies up to 100 trillion electron volts. The tell-tale clue to the discovery was the detection of two oppositely-located regions in the rapidly expanding remnant of the Supernova of 1006 AD. The ASCA satellite contains telescopes for simultaneously taking images and spectra of X-rays, allowing astronomers to distinguish between different types of X-ray emission from nearby regions of the same celestial object. ASCA was launched February 20, 1993. (NASA Release 95-208)

November 28: A fully automated landing of a transport aircraft was made using only engine thrust for control. Landing was a McDonnell Douglas MD-11 using a Propulsion Controlled Aircraft (PCA) system at NASA’s Dryden Flight Research Center. PCA is expected to become an important back-up system in the event of a loss of an aircraft’s hydraulic flight control system. (NASA Release 95-149; *Fla Today*, Sep 24/95; *AvWk*, Sep 4/95)

- Scientists at NASA’s Marshall Space Flight Center have determined a three-dimensional atomic structure of an important enzyme from one of four species of parasites that cause schistosomiasis. Using highly specialized X-ray equipment and protein crystallization techniques developed for space-based microgravity research, they were able to perform an important step leading to the use of drugs and vaccines. Schistosomiasis affects 200 to 300 million people and is second only to malaria in cause of death worldwide. (NASA Release 95-211; *Htsul Tms*, Dec 3/95)

December

December 1: NASA's Galileo spacecraft has confirmed it has reached the inside of Jupiter's magnetosphere. Direct measurements of the Jupiter system may now begin. Final tuning of the flight path is scheduled for December 2. On December 7, Galileo's previously deployed atmospheric probe will plunge into Jupiter's cloud tops and descend into the giant planet on a parachute. An hour after the probe mission is completed, Galileo will begin to fire its onboard rocket beginning a two year mission of close-up studies of the planet's large moons, Jupiter itself, and the magnetosphere. The spacecraft was launched aboard Space Shuttle Atlantis and an Interim Upper Stage (IUS) on October 18, 1989. (NASA Releases 95-207 & 215; *NY Times*, Dec 3/95, Dec 7/95, Dec 8/95 & Dec 11/95; *W Post*, Dec 4/95, Dec 8/95 & Dec 11/95; *USA Today*, Dec 1/95, Dec 7/95 & Dec 8/95; *Fla Today*, Dec 7/95; *WSJ*, Dec 7/95; *Time*, Dec 11/95; *Newsweek*, Dec 18/95; *AvWk*, Nov 27/95, Dec 4/95 & Dec 11/95; *Science*, Dec 15/95)

December 2: The Solar and Heliospheric Observatory (SOHO) satellite was launched to probe the Sun's hidden interior, its boiling atmosphere, and the physics behind the supersonic solar wind. SOHO is a joint project of the European Space Agency and NASA. It will be positioned at the point where the gravitational pull of the Sun and Earth cancel out. (*NY Times*, Dec 3/95 & Dec 5/95; *W Post*, Dec 3/95 & Dec 4/95; *USA Today*, Dec 4/95; *Fla Today*, Nov 22/95, Nov 24/95, Nov 28/95 & Dec 1/95; *CSM*, Nov 28/95; *Space News*, Nov 6/95; *AvWk*, Nov 13/95)

December 4: NASA's Office of Space Access and Technology selected 12 research proposals for negotiation. The proposals are for Phase II contracts in NASA's Small Business Technology Transfer (STTR) Pilot Program. The STTR program is similar to the Small Business Innovation Research Program (SBIRP) but varies by requiring small business concerns to conduct cooperative research and development by partnering with a research institution. At least 40 percent of the work must be performed by the small business concern, and at least 30 percent of the work must be performed by the research institute. STTR and SBIRP comprise only some of the many research grants NASA awards each year. (NASA Releases 95-46, 103, 165, 174, 183, 199, 210 & 214)

- The Hubble telescope has confirmed a second super-massive black hole. Located in the direction of the constellation Virgo, it has a mass 1.2 billion times that of the Sun. First identified in Hubble observations made in 1992, new Hubble images reveal the structure within the disk. In this case the disk is off-center, which is evidence for a dynamic close encounter. Another puz-

zling aspect is that the black hole is offset from the center of its galaxy. (NASA Release 95-216; *Science*, Dec 15/95)

December 15: A device invented at NASA's Langley Research Center may protect homeowners everywhere from deadly carbon monoxide fumes. It uses a new class of low-temperature oxidation catalysts to convert carbon monoxide to non-toxic carbon dioxide at room temperature. It also can remove formaldehyde gas. (NASA Release 95-218)

December 19: Daniel S. Goldin, head of the Nation's space agency, has won support in the White House for his philosophy of smaller, better, and less expensive spacecraft. A case in point is the early planning for a Pluto mission. Four years ago, engineers came up with a concept costing as much as \$4 billion. After many redesigns they developed a mission, called Pluto Express, at an estimated cost of \$400 million. Instead of packing many instruments into a single craft weighing several tons, engineers designed two lightweight craft weighing as little as 300 pounds each. In the proposed mission, the craft would be launched separately, perhaps by Russian Proton rockets, on "fast" trajectories. They should be able to reach Pluto in 6 to 8 years, compared to Voyager 2's travel time of 12 years to distant Neptune.

The Discovery program of small spacecraft is already a start in the direction of lower-cost flights. The large, ultimately unsuccessful Mars Observer was launched three years ago on a Titan 3 rocket costing \$350 million. But craft the size now being planned could be launched with less powerful Delta rockets costing \$60 million or less. (NASA Release 95-195; *NY Times*, Dec 19/95; *Space News*, Nov 27/95)

December 20: In the three years since NASA began funding a group consisting of five leading origin-of-life researchers and their 20 students at four separate institutions, they have published a bevy of high-profile papers and thrown fuel on a number of long-smoldering debates. The group believes that while science may not unravel the exact origin of life, it is constantly moving toward a plausible explanation of it. (*Science*, Dec 22/95)

Appendix A

SATELLITES, SPACE PROBES, AND HUMAN SPACE
FLIGHTS, 1991-1995

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Mar. 8 USA-69 17A Titan IV	Objective: Development of space-flight techniques and technology. Spacecraft: Not announced.	Not announced.	First launch of Titan IV from the WSMC. In orbit.
Apr. 5 Space Shuttle Atlantis (STS-37) 27A	Objective: To successfully launch the Gamma Ray Observatory. Spacecraft: Shuttle orbiter carrying satellite. Additional experiments include EVA Development Flight Experiments (EDFE), Ascent Particle Monitor (APM), Bioserve ITA Materials Dispersion Apparatus (BIMDA), Protein Crystal Growth-III (PCG-III), Shuttle Radiation Monitoring Equipment-III (RME-III), Air Force Maui Optical System (AMOS), and Space Station Heat Pipe Advanced Radiator Element-II (SHARE-II).	465.0 449.0 93.8 28.5	Thirty-ninth flight of the Space Transportation System. Piloted by Steven R. Nagel and Kenneth D. Cameron. Mission specialists Linda Godwin, Jerry L. Ross, and Jay Apt. Launched from KSC, Pad 39B at 9:22:45 a.m., EST. Landed at Edwards AFB, CA., Apr. 11 at 9:55 a.m., EST. Mission duration: 6 days, 32 min.
Apr. 7 Gamma Ray Observatory (GRO) 27B	Objective: To successfully launch satellite for two-year measurement of gamma rays covering most of the entire celestial sphere. Spacecraft: Rectangular shaped body with dual solar panels extending from the satellite. One high-gain and two low-gain antennas. Four scientific instruments include Burst and Transient Source Experiment (BATSE), Oriented Scintillation Spectrometer Experiment (OSSE), Imaging Compton Telescope (COMPTEL), and Energetic Gamma Ray Experiment Telescope (EGRET). Weight: 35,000 lbs.	444.0 432.0 93.3 28.5	Successfully launched from Shuttle Atlantis. A NASA cooperative program with the Federal Republic of Germany, with co-investigator support from The Netherlands, the European Space Agency, the United Kingdom, and the United States. Satellite placed in space by Remote Manipulator System (RMS) arm. Returning data. In orbit.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Apr. 28 Space Shuttle Discovery (STS-39) 31A	Objective: To conduct Air Force and Strategic Defense Initiative (SDIO) experiments in orbit. Spacecraft: Shuttle orbiter carrying satellites and additional scientific experiments.	263.0 249.0 89.4 56.9	Fortieth flight of the Space Transportation System. Piloted by Michael L. Coats and Blaine Hammond, Jr. Mission specialists Gregory L. Harbaugh, Donald R. McMonagle, Guion S. Bluford, C. Lacy Veach, and Richard J. Hieb. Launched from KSC Shuttle Landing Facility, Runway 15, at 2:55 p.m., EDT, May 6. Mission duration: 8 days, 7 hrs., 22 min.
Apr. 28 USA-70 31C	Objective: Developments of space flight techniques and technology. Spacecraft: Not announced.	Not announced.	Successfully deployed from Shuttle Discovery. In orbit.
May 1 Infrared Background Signature Survey (IBSS) 31B	Objective: To obtain scientific data for use in development of ballistic missile defense sensor systems for the Strategic Defense Initiative Organization (SDIO). Spacecraft: Shuttle Pallet Satellite II (SPAS II) Rectangular bus on which various experiments can be monitored. Weight: 4,197 lbs.	263.0 248.0 89.4 56.9	Successfully deployed from Shuttle cargo bay by Remote Manipulator System (RMS) arm, at 4:17 a.m., EDT. Discovery's manipulator arm grappled the payload at 6:25 p.m., EDT, May 2. Payload returned data on release of unsymmetric dimethyl hydrazine from Chemical Release Observation satellites. Returned to Earth in cargo bay of Discovery.
May 2 Chemical Release Observation (CRO) subsattellite 31D	Objective : To provide short-lived clouds of vapor and frozen particles in orbit for observation by IBSS orbiting payload. Spacecraft: Cylindrical	Not announced.	Successfully deployed from Shuttle Discovery. Reentered May 14.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
May 2 Chemical Release Observation (CRO) subsatellite 31E	Objective: To provide short-lived clouds of vapor and frozen particles in orbit for observation by IBSS orbiting payload. Spacecraft: Cylindrical.	Not announced.	Successfully deployed from Shuttle Discovery. Reentered May 12.
May 3 Chemical Release Observation (CRO) satellite 31F	Objective: To provide short-lived clouds of vapor and frozen particles in orbit for observation by IBSS orbiting payload. Spacecraft: Cylindrical.	Not announced.	Successfully deployed from Shuttle Discovery. Reentered May 13.
May 14 NOAA-12 32A Atlas E	Objective : To launch spacecraft into a Sun-synchronous orbit of sufficient accuracy to enable spacecraft to accomplish its operational mission. To acquire daily global weather information for the short- and long-term forecasting needs of the National Weather Service. Spacecraft: In launch configuration is 37 cm high, 188 cm in diameter; three-axis-stabilized. Instruments include Advanced Very High Resolution Radiometer (AVHRR), TIROS Operational Vertical Sounder System (TOVS), Space Environmental Monitor (SEM), and Argos Data Collection System (DCS) provided by France. Weight at launch: 1418 kg. Weight in orbit, with Apogee Kick Motor (AKM) expendables consumed: 735 kg.	841.0 821.0 101.3 98.7	Successfully launched by NASA from Vandenberg AFB, CA, Space Launch Complex 3 West (SLC-3W) at 11:52 a.m., EDT. Joins NOAA-10 and NOAA-11 in collecting meteorological and environmental data and will eventually replace NOAA-10, launched in Sept. 1986.
May 18 Soyuz TM-12			Crew consisted of Anatoly Artsebarsky, Sergei Krikalev, Helen Sharman. Docked with Mir Space Station. Helen Sharman first from United Kingdom to fly in space. Crew of Viktor Afanasyev, Musa Manarov, and Helen Sharman returned May 20, 1991. Artsebarsky and

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
			Krikalev remained on board Mir, with Artsebarsky returning on Oct. 10, 1991, and Krikalev doing so Mar. 25, 1992.
Jun. 5 Space Shuttle Columbia (STS-40) 40A	Objective: To carry Spacelab Life Sciences (SLS-1) dedicated life sciences research module in cargo bay. Spacecraft: Shuttle orbiter Columbia carrying SLS-1 and Get Away Special (GAS) Bridge experiments in the cargo bay. Middeck payloads: Physiological Monitoring System (PMS), Urine Monitoring System (UMS), and Animal Enclosures Modules (AEM). SLS-1 includes 18 primary scientific experiments.	302.0 276.0 90.1 39.0	Forty-first flight of the Space Transportation System. Piloted by Bryan D. O'Conner and Sidney M. Gutierrez. Mission specialists James P. Bagian, Tamara E. Jernigan, and M. Rhea Seddon. Payload specialists Francis A. (Drew) Gaffney and Millie Hughes-Fulford. Launched from KSC, Pad 39B, at 9:24 a.m., EDT. Landed at Edwards AFB, CA, 11:39 a.m., EDT, Jun. 14. Mission duration: 9 days, 2 hrs., 15 min.
Jun. 29 Radiation Experiment (REX) 45A Scout	Objective: To launch U.S. Air Force radiation experiment satellite. Spacecraft: Not announced. Weight: 188 lbs.	871.0 770.0 101.3 89.6	Successfully launched by NASA for Air Force from Vandenberg AFB, CA, Space Launch Complex (SLC) 5, at 10:00 a.m., EDT. Test of sophisticated communications in a high-radiation environment. In orbit.
Jul. 4 USA-71 47A Delta II	Objective: To place satellite into successful orbit from which Navy objectives can be met. Spacecraft: Not announced.	20,250.0 19,451.0 704.6 55.3	Eleventh in a series of operational Navstar Global Positioning Satellites (GPS) launched by Air Force expendable booster. Operational system to be composed of 24 satellites in 6 orbital planes. In orbit.

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LOSAT-X 47B	Objective: Development of space flight techniques and technology. Spacecraft: Not announced.	416.0 402.0 92.8 40.0	Secondary payload launched by Delta II. Reentered Nov. 15, 1991
Jul. 17 Microsat-1 51A Pegasus	Objective: To launch small satellite for communications experiment. Spacecraft: Seven and 1/2 inches high, 19 inches wide. Weight: 49 lbs.	454.0 356.0 92.7 82.0	Successfully launched by Pegasus vehicle carried to altitude by NASA B-52 off CA coast. Satellite sponsored by the Defense Advanced Research Projects Agency (DARPA). In orbit.
Microsat-2 51B	Objective: To launch small satellite for communications experiment. Spacecraft: Seven and 1/2 inches high, 19 inches wide. Weight: 49 lbs.	457.0 359.0 92.7 82.0	Second of seven satellites launched for DARPA. In orbit.
Microsat-3 51C	Objective: To launch small satellite for communications experiment. Spacecraft: Seven and 1/2 inches high, 19 inches wide. Weight: 49 lbs.	442.0 355.0 92.5 82.0	Third of seven satellites launched for DARPA. In orbit.
Microsat-4 51D	Objective: To launch small satellite for communications experiment. Spacecraft: Seven and 1/2 inches high, 19 inches wide. Weight: 49 lbs.	457.0 359.0 92.7 82.0	Fourth of seven satellites launched for DARPA. In orbit.
Microsat-5 51E	Objective: To launch small satellite for communications experiment. Spacecraft: Seven and 1/2 inches high, 19 inches wide. Weight: 49 lbs.	457.0 360.0 92.7 82.0	Fifth of seven satellites launched for DARPA. In orbit.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Microsat-6 51F	Objective: To launch small satellite for communications experiment. Spacecraft: Seven and 1/2 inches high, 19 inches wide. Weight: 49 lbs.	458.0 359.0 92.7 82.0	Sixth of seven satellites launched for DARPA. In orbit.
Microsat-7 51G	Objective: To launch small satellite for communications experiment. Spacecraft: Seven and 1/2 inches high, 19 inches wide. Weight: 49 lbs.	458.0 359.0 92.7 82.0	Seventh of seven satellites launched for DARPA. In orbit.
Aug. 2 Space Shuttle Atlantis 54A	Objective: To successfully place in orbit NASA's fourth Tracking and Data Relay Satellite (TDRS-5). Spacecraft: Shuttle orbiter carrying satellite with Inertial Upper Stage (IUS). Cargo bay payloads: Station Heat Pipe Advanced Radiator Element-II (SHARE-II), Shuttle Solar Backscatter Ultraviolet Experiment (SSBUV), and Optical Communications Through the Shuttle Window (OCTW). Middeck payloads: Air Force Maui Optical System (AMOS), Auroral Photography Experiment-B (APE-B), Bioservice-Instrumentation Technology Associates Materials Dispersion Apparatus (BIMDA), Investigations into Polymer Membrane Processing (IPMP), Protein Crystal Growth-III (PCG-III), Space Acceleration Measurement System (SAMS), Solid Surface Combustion Experiment (SSCE), and Tank Pressure Control Experiment (RPCE). Weight of experiments: 2,699 lbs.	329.0 309.0 90.6 28.4	Forty-second flight of the Space Transportation System. Piloted by John E. Blaha and Michael A. Baker. Mission specialists Shannon W. Lucid, G. David Low, and James C. Adamson. Launched from KSC, Pad 39A, 11:02 a.m., EDT. Landed at KSC Shuttle Landing Facility, Aug. 11, at 8:23 a.m., EDT. Mission duration: 8 days, 21 hrs., 21 min.

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Aug. 2 Tracking and Data Relay Satellite 5 (TDRS-5) 54B	Objective: To launch satellite to TDRS-3, into successful geosynchronous orbit with sufficient station-keeping fuel on board to complete the on-orbit constellation and meet NASA requirements to provide full-capability user support services. Spacecraft: Three-axis stabilized, momentum-biased configuration with two Sun-oriented solar panels attached. TDRS measures 57.17 ft. tip to tip of deployed solar panels. Composed of three modules: (1) equipment module houses altitude control, electric power, propulsion, telemetry, tracking and command subsystems; (2) payload module consists of processing and frequency-generation equipment; (3) antenna module supports dual deployable and fixed antennas, multiple-access array, and remainder of telecommunications hardware. Weight at launch, including IUS: 37,640 lbs. In orbit TDRS-5 will weigh 4,637 lbs. and measure 57.2 ft. from tip to tip of solar panels by 46.6 ft. from outer edge to edge of its Single Access antenna.	39,011.0 38,855.0 1,599.8 0.1	Successfully launched from Atlantis and successfully transferred to geosynchronous orbit by IUS. Placed at 175-degree-W longitude. Oct. 7 officially replaced TDRS-3 as primary provider of customer supporter in the western location. In orbit.
Sep. 12 Space Shuttle Discovery (STS-48) 63A	Objective: To successfully launch Upper Atmosphere Research Satellite (UARS) and conduct other experiments. Spacecraft: Shuttle orbiter carrying satellite with additional experiments. Cargo Bay: Atmospheric Particle Monitor-3 (APM-3). Middeck payloads: Radiation Monitoring Equipment-III (RME-III 06), Protein Crystal Growth-7 (PGC-7), Middeck 0-G Gravity Dynamics Experiment-1 (MODE-01), Investigations into Polymer	553.0 538.0 95.4 56.9	Forty-third flight of the Space Transportation system Piloted by John Creighton and Kenneth Reightler, Jr. Mission specialists Charles D. Gemar, James F. Buchli, and Mark N. Brown. Launched from Pad 39A, KSC, at 7:11 p.m., EDT. Landed at Edwards AFB, CA, 3:38 a.m., EDT, Sep. 18. Weather conditions forced change of landing site from

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	Membrane Processing-4 (IPMP-04), Physiological and Anatomical Rodent Experiment-1 (PARE-1), Shuttle Activation Monitor-1 (SAM-03), Cosmic Radiation Effects and Activation Monitor-1 (CREAM-01), Air Force Maui Optical System-12 (AMOS), and Electronic Still Photography Camera. Weight: 475 lbs.	580.0 574.0 96.2 57.8	KSC. Mission duration: 5 days, 8 hrs., 28 min.
Sep. 15 Upper Atmosphere Remote Research Satellite (UARS) 63B	Objective: To launch satellite to study mankind's effect on planet's atmosphere and its shielding ozone layer. Spacecraft: Containing nine complimentary experiments: Cryogenic Limb Array Etalon Spectrometer (CLAES), Improved Stratospheric and Mesospheric Limb Sounder (ISAMS), Microwave Limb Sounder (MLS), and Halogen Occultation Experiment (HALOE) to measure the chemistry of the atmosphere; High Resolution Doppler Imager (HRDI) and Wind Imaging Interferometer (WINDII) to measure the dynamics of the atmosphere; Solar Ultraviolet Spectral Irradiance Monitor (SUSIM), Solar/Stellar Irradiance Comparison Experiment (SOLSTICE), and Particle Environment Monitor (PEM) to determine energy inputs from the Sun and Earth's magnetosphere. A tenth instrument, Active Cavity Radiometer Irradiance Monitor II (ACRIM II), will extend long-term measurements of the solar constant, 3-axis stabilized spacecraft body. Weight: 14,419 lbs.		Satellite successfully launched from Discovery cargo bay by Remote Manipulator System (RMS) arm at 12:23 a.m., EDT. Will make measurements over the full range of local times at most geographic locations every 36 days. First major flight element of NASA's Mission to Planet Earth. Design life of 36 months. Returning data. In orbit.

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Oct. 2 Soyuz TM-13			Crew consisted of Aleksandr Volkov, Toktar Aubakirov (Kazakh Republic), and Franz Viehboeck (Austria). Docked with Mir Space Station. Crew returned Oct. 10, 1991, with Anatoly Artsebarsky.
Nov. 8 USA-72 76A Titan IV	Objective: To place satellite into successful orbit from which DoD objectives can be met. Spacecraft: Not announced.	Not announced.	In orbit.
Nov. 8 USA-74 76C Titan IV	Objective: To place satellite in successful orbit from which DoD objectives can be met. Spacecraft: Not announced.	Not announced.	In orbit.
Nov. 8 USA-76 76D Titan IV	Objective: To place satellite into successful orbit from which DoD objectives can be met. Spacecraft: Not announced.	Not announced.	In orbit.
Nov. 8 USA-77 76-E Titan IV	Objective: To place satellite into successful orbit from which DoD objectives can be met. Spacecraft: Not announced.	Not announced.	In orbit.
Nov. 24 Space Shuttle Atlantis (STS-44) 80A	Objective: To deploy a Defense Support Program (DSP) satellite and to work with a variety of secondary payloads: Interim Operational Contamination Monitor in the Cargo Bay; Terra Scout, Military Man in Space (M88-1), Air Force Maui Optical System, Cosmic Radiation Effects and Activation Monitor, Shuttle Activation Monitor, and 3 others as Middeck Payloads. Spacecraft: Shuttle orbiter carrying the experiments listed above.	368.0 361.0 91.6 28.4	Forty-fourth flight of the Space Transportation System. Piloted by Fred Gregory and Tom Henricks. Mission specialists Jim Voss, Story Musgrave, and Mario Runco, Jr. Payload specialist Tom Hennen. Launched from KSC 6:44 p.m., EST. Landed at Edwards AFB, CA, 5:34 p.m., EST, Dec. 2. Mission duration: 6 days, 22 hrs., 51 min.

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Nov. 25 Defense Support Program (DSP-I) USA-75 80B	Objective: To launch an enhanced Defense Support Program (DSP) satellite, the third in the "DSP-I" block of satellites. Spacecraft: A survivable and reliable system that detects and reports on real-time missile launches, space launches, and nuclear detonations.	Not announced.	Satellite successfully launched from Atlantis by an Inertial Upper Stage with two solid rocket motors at 7:16 a.m., EST. The DSP satellite weighs approximately 2,360 kg, and is about 10 meters long. It measures about 6.7 meters across its deployed solar array surface area and employs infrared detectors to sense heat from missile plumes.
Nov. 28 Defense Meteorological Satellite (F11) USA-73 82A Atlas E	Objective: To launch the first of the improved Block 5D-2 satellites in the Defense Meteorological Satellite Program. The sensor complement on this satellite includes the first water vapor profiler placed in orbit. This sensor provides information on the vertical humidity profile and water vapor content on a global basis.	855.0 835.0 101.8 98.9	One in a series of Defense Meteorological Satellites. Launched from SLC-3W of Vandenberg AFB, CA.

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Jan. 22 Space Shuttle Discovery (STS-42) 2A	Objective: To conduct a world-wide research effort in the behavior of materials and life in weightlessness. Spacecraft: Shuttle orbiter carrying the International Microgravity Laboratory-1 (IML-1) in the cargo bay. IML-1 included 42 experiments in life and materials sciences. In addition STS-42 included Get Away Special payloads from 6 countries, including China for the first time, and the 5th Shuttle flight of the Investigations into Polymer Membrane Processing (IPMP), among others.	305.0 392.0 90.5 56.9	Forty fifth flight of the Space Transportation System. Piloted by Col. Ronald J. Grabe (USAF) and Stephen S. Oswald. Mission specialists Dr. Norman E. Thagard, MD, Lt. Col. David C. Hilmers (USMC), and William F. Raddy. Payload specialists Dr. Roberta L. Bondar, PhD and MD of the CSA, and Ulf Merbold of the ESA. Launched 9:55 a.m., EST from Kennedy Space Center. Landed 11:07 a.m., EST, Jan. 30 at Edwards AFB.
Feb. 10 DSCS III USA-78 6A Atlas II	Objective: To launch a new Defense Satellite Communications System (DSCS III) satellite. Spacecraft: 110" long, 76" wide, 77" deep. Six SHF channels.	Not announced.	This launch marked the start of a replenishment program for the DSCS constellation of satellites.
Feb. 23 GPS USA-79 9A Delta II	Objective: To add to the existing constellation of Global Positioning System satellites in orbit. Spacecraft: A Block IIA satellite operating in inclined, semi-synchronous orbit.	20,323.0 20,039.0 717.9 54.6	Twelfth in a series of operational GPS satellites. System expected to be composed of 24 satellites in 6 orbital planes. In orbit.
Mar. 14 Galaxy 5 13A Atlas I	Objective: To launch a commercial communications satellite. Spacecraft: A communications satellite carrying 24 C-band transponders.	35,789.0 35,787.0 1,436.1	Launched from Cape Canaveral, AFS, FL. In orbit.
Mar. 17 Soyuz TM-14			Crew consisted of Alexandr Viktorenko, Alexandr Kaleri, Klaus-Dietrich Flade (Germany). First manned CIS space mission. Docked with Mir

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			Space Station Mar. 19. The TM-13 capsule with Flade, Aleksandr Volkov, and Sergei Krikalev returned to Earth Mar. 25. Krikalev had been in space 313 days. Viktorenko and Kaleri remained in the TM-14 spacecraft. Flight time: 145 days, 15 hrs., 11 min.
Mar. 24 Space Shuttle Atlantis (STS-45) 15A	Objective: To study the Sun, the upper reaches of the Earth's atmosphere, and astronomical objectives. Spacecraft: Shuttle orbiter carrying the Atmospheric Laboratory for Applications and Science-1 (ATLAS-1) containing 12 instruments from 7 countries that will conduct 13 experiments to study the chemistry of the atmosphere, solar radiation, space plasma physics, and ultraviolet astronomy. STS-45 also carried other experiments, including IPMP.	304.0 292.0 90.4 57.0	Forty-sixth flight of the Space Transportation System. Piloted by Col. Charles F. Bolden (USMC) and Lt. Col. Brian Duffy (USAF). Mission specialists Kathryn D. Sullivan, Capt. David C. Leestma (USN), and Michael Foale. Payload specialists Dirk D. Frimout (ESA) and Byron K. Lichtenberg. Launched at 6:13 a.m., EST from KSC. Landed 6:23 a.m., EST at Rwy 33 of the KSC Shuttle Landing Facility on Apr. 2.
Apr. 10 GPS USA-80 19A Delta II	Objective: To add to the existing constellation of Global Positioning Systems satellites in orbit. Spacecraft: A Block IIA satellite operating in inclined, semi-synchronous orbit.	20,381.0 19,981.0 718.0 55.2	Thirteenth in a series of operational GPS satellites. System expected to be composed of 24 satellites in 6 orbital planes. In orbit.
Apr. 25 USA-81 23A Titan IV	Objective: To place satellite into successful orbit from which DoD objectives can be met. Spacecraft: Not announced.	Not announced.	Launched from Vandenberg AFB, CA. In orbit. Forty-seventh flight of the Space

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May 7 Space Shuttle Endeavour (STS-49)	Objective: To rendezvous with, repair, and reboost a crippled INTELSAT VI communications satellite. Spacecraft: Shuttle orbiter with INTELSAT perigee kick motor and support equipment, including a capture bar assembly, plus equipment to demonstrate and verify Space Station Freedom maintenance and assembly tasks as well as a protein crystal growth experiment. First flight of newest orbiter, Endeavour.	375.0 363.0 91.9 28.3	Transportation System. Piloted by Capt. Daniel C. Brandenstein (USN) and Lt. Col. Kevin P. Chilton (USAF). Mission specialists Richard J. Hieb, Cmdr. Bruce E. Melnick (USCG), Cmdr. Pierre J. Thout (USN), Kathryn C. Thornton, and Thomas D. Akers. Launched 7:40 p.m., EDT from KSC. Landed 4:57 p.m., EDT, May 16 at Edwards AFB.
May 14 Palapa B-4 27A Delta	Objective: To launch an Indonesian communications satellite.	35,799.0 35,777.0 1,436.2 0.0	Launched by a Delta rocket. Specifics unavailable.
Jun. 7 Extreme Ultraviolet Explorer (EUVE) 31A Delta II	Objective: To launch a satellite that will make both spectroscopic and wide-band observations over the entire extreme ultraviolet spectrum. Spacecraft: Rectangular shaped body with dual solar arrays. Four telescopes each 40 centimeters across: three scanners and one deep survey/spectrometer telescope.	532.0 517.0 95.1 28.4	Launched aboard a Delta II rocket from Cape Canaveral. Returning data. In orbit.
Jun. 10 INTELSAT-K 32A Atlas IIA	Objective: To launch the highest powered Intelsat satellite to date. Spacecraft: A communications satellite equipped with sixteen 54 megahertz transponders.	35,791.0 35,782.0 1,436.1 0.0	Launched on an Atlas IIA from Cape Canaveral AFS. In orbit. Entered into service Sep. 1, 1992. Forty-eighth flight of the

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Jun. 25 Space Shuttle Columbia (STS-50) 34A	Objective: To perform around-the-dock investigations of the effects of weightlessness on plants, humans, and materials. Spacecraft: Shuttle orbiter carrying U.S. Microgravity Laboratory-I, including 31 experiments ranging from manufacturing crystals for possible semiconductor use to the behavior of weightless fluids. Also includes the Investigations into Polymer Membrane Processing experiment and the Space Shuttle Amateur Radio Experiment-II.	309.0 297.0 90.6 28.5	Space Transportation System. Piloted by Richard N. Richards and Kenneth D. Bowersox. Mission specialists Bonnie Dunbar, Ellen Baker, and Col. Carl Meade (USAF). Payload specialists Lawrence J. DeLucas and Eugene H. Trinh. Launched from KSC at 12:12 p.m., EDT. Landed at KSC July 9 at 7:43 a.m., EDT after a record-breaking 13 days, 19 hrs., and 31 minutes flight.
Jul. 2 DSCS III USA-82 37A Atlas II	Objective: To launch a new Defense Satellite Communications System (DSCS) III satellite. Spacecraft: 110" long, 76" wide, 77" deep. Six SHF channels.	Not announced.	In orbit.
Jul. 3 Solar, Anomalous and Magnetospheric Particle Explorer (SAMPEX) 38A Scout	Objective: To launch the first spacecraft in a new series of Small Explorers designed to investigate anomalous cosmic rays, galactic cosmic rays in the vicinity of Earth, solar energetic particles, and other phenomena of space physics. Spacecraft: The first in NASA's new Small Explorer series, the rectangular spacecraft weighing 348 pounds; 4.5 feet tall and 2.8 feet wide without its two solar arrays deployed; they extended its width to 6.9 feet. Carries four cosmic monitoring instruments.	684.0 511.0 96.7 81.7	Launched into near-polar orbit by a Scout rocket at 10:19 a.m., EDT from Vandenberg AFB. In orbit. Built by the Goddard Space Flight Center, SAMPEX carries scientific instruments from the University of Maryland, California Institute of Technology, the Aerospace Corporation, and the Max Planck Institute for Extraterrestrial Physics in Germany.
Jul. 7 GPS USA-83 39A Delta II	Objective: To add to the existing constellation of Global Positioning System satellites in orbit. Spacecraft: A Block IIA satellite operating in inclined, semi-synchronous orbit.	20,403.0 19,960.0 718.0 55.0	Fourteenth in a series of operational GPS satellites. System expected to be composed of 24 satellites in 6 orbital planes. In orbit. Launched by a Delta II—the first such

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Jul. 24 Geotail 44A Delta II	Objective: To investigate the geomagnetic tail region of the magnetosphere. Spacecraft: A spin-stabilized, cylindrical satellite approximately 2.2 meters in diameter, a height of 1.6 meters and a weight of about 1,009 kg. with 2 mechanically despun antennas. Designed by the Institute of Space and Astronautical Science (ISAS) of Japan, with 2 ISAS, 2 NASA, and 3 joint ISAS/NASA instruments. An element in the International Solar Terrestrial Physics (ISTP) Program.	341,116.0 184.0 2,354.5 28.7	launch under NASA's Medium ELV launch service contract with McDonnell Douglas Corporation—at 10:26 a.m., EDT from Cape Canaveral. The initial orbit is far distant from the Earth and will last about 2 and a 1/4 years, after which the satellite will be maneuvered closer in to measure the mid-magnetosphere instead of the geomagnetic tail region of the magnetosphere examined earlier. In orbit.
Jul. 27 Soyuz TM-15			Crew consisted of Anatoly Solovyov, Sergei Avdeyev, and Michael Tognini (France). Docked with Mir Space Station Jul 29. Tognini returned to Earth in TM-14 capsule with Aleksandr Kaleri. Solovyov and Avdeyev spent over six months in the Mir orbital complex and returned to Earth in the descent vehicle of the TM-15 space craft on 1 February 1993.
Jul. 31 Space Shuttle Atlantis (STS-46) 49A	Objective: To evaluate the capability for safely deploying, controlling and retrieving a tethered and to demonstrate the capability of the system to serve as a facility for research in geophysical and space physics. Spacecraft: Shuttle orbiter carrying Tethered Satellite System-1, a joint project of the United States and Italy, weighing 1,139 lbs. The crew was able to deploy the TSS satellite to only 256 meters instead of the goal of 20	306.0 299.0 90.6 28.5	Forty-ninth flight of the Space Transportation System. Piloted by Col. Loren J. Shriver (USAF) and Maj. Andrew M. Allen (USMC). Mission specialists Claude Nicollier (ESA), Marsha S. Ivins, Jeffrey A. Hoffman, and Franklin R. Chang-Diaz. Payload specialist Franco Malerba (Italian Space Agency). Atlantis launched 9:56

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	kilometers. Other payloads included ESA's Eureka-1, an IMAX camera for filming parts of the mission, and 4 experiments.		a.m., EDT from KSC. Landed at KSC Shuttle Landing Facility at 9:12 a.m., EDT Aug. 8.
Aug. 2 Eureka-1 49B	Objective: To perform research in the fields of material and life sciences plus radio-biology in a controlled microgravity environment at an operational orbit of 515 km. and return to a lower orbit for retrieval by another orbiter. Spacecraft: European Retrievable Carrier (Eureka) designed and developed by ESA. A rectangular satellite with twin solar arrays, equipped with an altitude and orbit control system to keep disturbance or microgravity experiments at a Launch Mass: 4,491 kg.	509.05504.0 94.8 28.5	Successfully deployed by Space Shuttle Atlantis and subsequently boosted to its desired orbit using its own propulsion on Aug. 6. To remain in orbit for 6 to 9 months before retrieval.
Aug. 10 TOPEX/POSEIDON 52A Ariane 42P	Objective: To increase our understanding of global ocean dynamics by making precise and accurate observations of sea level, thus yielding global ocean topography. Spacecraft: Basically rectangular satellite with a single solar array and five instruments: 3 provided by NASA (a Dual-Frequency Radar Altimeter, the TOPEX Microwave Radiometer, and a Global Positioning Demonstration Receiver) and 2 by the French Centre D'Etudes Spatiales (a Dual-Doppler Tracking System Receiver and a Single-Frequency Solid-State Radar Altimeter). Joint U.S.-French spacecraft, part of NASA's Mission to Planet Earth. Weight: 2,520 kg.; length: 5.5 m.; span: 11.5 m.; height: 6.6 m.	1,341.0 1,330.0 112.4 66.0	Successfully launched from Kourou, French Guiana on an Ariane 42P booster at 8:08 p.m. local time. On Sep. 21, the satellite completed the last of 6 maneuvers that placed it in the required orbit.

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Aug. 31 Satcom C4 57A Delta II	Objective: To launch a commercial communications satellite. Spacecraft: A communications satellite to support cable TV programming.	35,814.0 35,761.0 1,436.2 0.2	Successfully launched from Cape Canaveral. In orbit.
Sep. 9 GPS USA-84 Delta II	Objective: To add to the existing constellation of <i>Global Positioning System</i> satellites in orbit. Spacecraft: A Block IIA satellite operating in inclined, semi-synchronous orbit.	20,630.0 19,979.0 723.0 54.8	Fifteenth in a series of operational GPS satellites. System expected to be composed of 24 satellites in 6 orbital planes. In orbit.
Sep. 10 Satcom C3 60B Ariane 44LP	Objective: To launch a commercial communications satellite. Spacecraft: A communications satellite to provide domestic service.	35,799.0 35,780.0 1,436.3 0.1	Successfully launched from Kourou, French Guiana by an Ariane 44LP. In orbit.
Sep. 12 Space Shuttle Endeavour (STS-47) 61A	Objective: To perform successfully the materials and life sciences investigation of Spacelab 1, a joint laboratory sponsored by NASA and the National Space Development Agency (NASDA) of Japan. Spacecraft: Shuttle orbiter carrying 24 materials science and 19 life science investigations involving government, industry, and university sponsors in Japan and the U.S. STS-47 secondary objectives, including 9 Get Away Special (GAS) experiments, the Israel Space Agency Investigation about Hornets (ISAAH), Shuttle Amateur Radio Experiment (SAREX), and the Solid Surface Combustion Experiment (SSCE). Payload weight: about 28,158 lbs.	301.0 297.0 90.5 56.9	Fiftieth flight of Space Transportation System. Piloted by Robert L. Gibson and Curtis L. Brown, Jr. Mission specialists Mark C. Lee, Jerome Apt, N. Jan Davis, and Dr. Mae C. Jemison, the first African-American woman to fly in space. Payload specialist Mamoru Mohri, the first Japanese to fly aboard a NASA spacecraft. Lee and Davis were the first married couple in space together. Endeavour launched at 10:23 a.m., EDT from KSC. Landed there at 8:53 a.m., EDT on Sep. 20.

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Sep. 25 Mars Observer 63A Titan III	Objective: To study the geology, geophysics, and climate of Mars. Spacecraft: Rectangular satellite with solar power, 7 complementary instruments (Gamma Ray Spectrometer, Mars Observer Science Camera, Thermal Emission Spectrometer, Pressure Modulator Infrared Radiometer, Mars Observer Laser Altimeter, Radio Science, and Magnetometer and Electron Reflectometer) and a Mars Balloon Relay to relay scientific telemetry from equipment deployed by the Russian Mars 94 mission.	On way to Mars orbit.	Successfully launched from Complex 40 at Cape Canaveral AFS at 1:05 p.m., EDT with its Transfer Orbit Stage to a parking orbit from which the TOS ignited setting satellite on its 11-months journey to Mars orbit, expected to begin in August 1993.
Oct. 12 DFS-3 66A Delta II	Objective: To provide television, radio, and data communication services throughout Germany. Spacecraft: Kopernicus.	35,832.0 35,738.0 1,436.1 0.0	Launched by McDonnell Douglas for Germany. In geosynchronous orbit.
Oct. 22 Space Shuttle Columbia (STS-52) 70A	Objective: To study the influence of gravity on basic fluid and solidification process using U.S. Microgravity Payload (USMP)-1 and to deploy the second Laser Geodynamics Satellite (LAGEOS II) to measure the Earth's crustal movement plus nine secondary payloads in an international mission with cooperative efforts between NASA and the French, Italian, and Canadian space programs as well as the European Space Agency (ESA).	299.0 290.0 90.4 28.4	Fifty-first flight of the Space Transportation System (STS). Piloted by James D. Wetherbee and Michael A. Baker. Mission specialists Charles L. Veach, William M. Shepherd, Tamara E. Jernigan. Payload specialist Steven C. MacLean. Launched from KSC 1:09 p.m., EDT. Landed at KSC 9:05 a.m., EST, Nov. 1. Mission duration: 9 days, 20 hrs, 57 minutes.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Oct. 23 LAGEOS II 70B	Objective: To measure regional crustal deformation, improve geodetic reference datum and Earth orientation, measure secular variation in Earth's polar axis plus variations in Earth rotation. Spacecraft: No moving parts, designed for use as target for laser ranging from 65 sites around the world, operated by 30 countries.	5,951.0 5,616.0 222.5 52.7	In a joint NASA and Italian Space Agency mission, the passive satellite was successfully launched from Columbia at 9:56 a.m. EDT. In orbit.
Oct. 31 CTA 70C	Objective: To test the Canadian Space Vision System, itself designed to enhance human vision in connection with operation of the Canada arm, by taking it through a series of maneuvers, and then to release and track the Canadian Target Assembly (CTA) in space using the Space Vision System. Spacecraft: A small satellite.	243.0 164.0 88.4 28.4	Released from Columbia and tracked on Oct. 31. Reentered the atmosphere and burned up Nov. 1.
Nov. 21 MSTI-1 78A Scout	Objective: To demonstrate low-cost, light-weight modular test bed for Miniature Seeker and Sensor technologies. Spacecraft: A Block II satellite in the NAVSTAR Global Positioning System.	20,251.0 18,341.0 681.4 53.5	Sixteenth in a series of operational GPS satellites. System expected to be composed of 24 satellites in inclined, semi-synchronous orbit. In orbit.
Nov. 28 USA 86 83 A Titan IV	Objective: To deliver a classified payload into orbit. Spacecraft: Not announced.	Not announced.	Launched from Vandenberg AFB, CA. In orbit.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Dec. 2 Space Shuttle Discovery (STS-53) 86A	Objective: To deploy the last major DoD classified payload currently planned for the Shuttle fleet. Secondary objectives include ten different payloads including Space Tissue Loss (STL) and Battlefield Laser Acquisition Sensor Test (BLAST). Spacecraft: Shuttle orbiter with 13 detailed test objectives and 12 detailed supplementary objectives.	381.0 372.0 92.0 57.0	Fifty-second STS flight. Piloted by David M. Walker and Robert D. Cabana. Mission specialists Guion S. Blufford, Jr., James. S. Voss, and Michael Richard Clifford. Launched from KSC at 8:24 a.m. EST. Landed Edwards AFB, CA, 3:43 p.m. EST, Dec. 9. Mission duration: 7 days, 7 hrs., 19 min.
Dec. 2 DoD 1 USA 89 86B	Objective: To deliver a classified payload into orbit. Spacecraft: Deployable spacecraft and associated airborne deployment system.	Not announced.	Launched from Discovery, 9th dedicated DoD Shuttle mission. In orbit.
Dec. 18 GPS USA 87 89A Delta II	Objective: To provide radio positioning and navigation, including position, velocity, and timing data to the DoD and civilian users. Spacecraft: A Block II satellite in the NAVSTAR Global Positioning System.	20,323.0 20,039.0 718.0 54.7	Seventeenth in a series of operational GPS satellites. System expected to be composed of 24 satellites in inclined, semi-synchronous orbit. In orbit.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Jan. 13 TDRS-6 3B	Objective: To deploy Tracking and Delta Relay Satellite (TDRS-6) and operate the Diffused X-ray Spectrometer Hitchhiker experiment to collect data on stars and the surrounding galactic gasses. Other objectives included the second Physiological and Anatomical Rodent Experiment (PARE-2), a Solid Surface Combustion Experiment, and the second group of Physics of Toys experiments to be broadcast to classrooms throughout the nation. Spacecraft: Shuttle orbiter with above experiments and equipment.	307.0 302.0 90.6 54.7	Fifty-third STS flight. Piloted by John H. Casper and Donald R. Monagle. Mission specialists Gregory J. Harbaugh, Mario Runco, Jr., and Susan J. Helms. Launch from KSC at 8:59 a.m., EST. Landed at KSC 8:38 a.m., EST, Jan 20. Mission duration: 6 days, 23 hrs., 39 min.
Jan. 13 TDRS-6 3B	Objective: To launch the sixth in a series of communications satellites in the Tracking and Data Relay Satellites System (TDRSS) to provide communications with the Space Shuttle and other spacecraft in low-Earth orbit. Spacecraft: Satellite equipped with two solar arrays, two single access antennae, a C-band antenna, a K-band antenna, and an omni antenna.	35,708.0 35,704.0 1,431.9 0.5	Designated TDRS F until in orbit. Following its release from Endeavour's cargo bay, on Jan. 14, it reached its initial destination following two successful booster firings of the inertial upper stage. In orbit.
Jan. 24 Soyuz TM-16			Crew consisted of Gennady Manakov and Aleksandr Poleshchuk. Docked with Mir Space Station Jan. 26. On July 22, 1993, the TM-16 descent cabin landed back on Earth with Manakov, Poleshchuk, and French cosmonaut Jean-Pierre Haignere from Soyuz TM-17 on board.

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Feb. 3 GPS USA 88 7A Delta II	Objective: To provide radio positioning and navigation, including position, velocity, and timing data to the DoD and civilian users. Spacecraft: A Block II satellite in the NAVSTAR Global Positioning System.	20,359.0 20,005.0 718.0 54.8	Eighteenth in a series of operational GPS satellites. System expected to be composed of 24 satellites in inclined, semi-synchronous orbit. In orbit.
Feb. 9 QXP-1 9A Pegasus	Objective: To demonstrate new, commercial, global, mobile communications from low-Earth orbit. Spacecraft: An experimental, demonstration satellite weighing about 32 lbs., the size of a large briefcase, for transmitting brief messages with hand-held communicators.	794.0 732.0 100.1 25.0	Launched by Pegasus rocket, carried to 40,000 feet for release and first-stage motor ignition in a NASA B-52, which had taken off from KSC. In orbit.
Feb. 9 SCD-1 9B Pegasus	Objective: To monitor cloud cover, rainfall, flood and tide levels, and air quality over Brazil. Spacecraft: Satellite de Coleta de Dados (SCD), a remote, sensing spacecraft that collects environmental data from ground sensors in the Amazon River Basin.	793.0 729.0 100.1 25.0	Launched by Pegasus rocket, carried to 40,000 feet for release and first-stage motor ignition in a NASA B-52, which had taken off from KSC. In orbit.
Mar. 25 UFO-1 15A Atlas-Centaur II	Objective: To provide communications and UHF links for the U.S. Navy, Strategic Command, and Army/Marine Rapid Deployment Forces. Spacecraft: A 6,319-pound satellite with a planned lifetime of 14 years and greater communications capacity than the Navy's current communications spacecraft.	36,108.0 36,041.0 1,450.9 27.1	Because of malfunction of the Atlas stage, the satellite went into lower orbit than required. With insufficient fuel to move it to operational orbit, the Navy moved it above geosynchronous altitude and declared it a total loss. In orbit.
Mar. 30 GPS USA 90 17A Delta II	Objective: To provide radio positioning and navigation, including position, velocity, and timing data to DoD and civilian users. Spacecraft: A Block II satellite in the NAVSTAR Global Positioning System.	20,292.0 20,073.0 718.0 55.0	Nineteenth in a series of operational GPS satellites. System expected to be composed of 24 satellites in inclined, semi-synchronous orbit. In orbit.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Mar. 30 SEDS I 17B Delta II	Objective: To allow scientists to compare data on actual tether dynamics with computer models of predicted behavior. Spacecraft: The Small Expendable Tether Deployable System (SEDS I), an 85-pound satellite attached by a 20-kilometer-long flexible cable to Delta's second stage.	Not announced.	During the 80-minute deployment, the entire length of tether slowly unreeled until the payload began swinging like a pendulum. Once it ceased swinging and came to a vertical position, it was severed and allowed to burn up as it reentered the Earth's atmosphere.
Apr. 8 Space Shuttle Discovery (STS-56) 23A	Objective: To provide the orbiter Discovery and the Spacelab pallet as a platform for experiments on the Atmospheric Laboratory for Applications and Science (ATLAS) payload, to monitor global ozone with the Shuttle Solar Backscatter Ultraviolet instruments, and to study the solar wind and the Sun's corona, among other purposes. Spacecraft: Shuttle orbiter featuring 12 development test objectives and 15 detailed supplemental objectives.	307.0 295.0 90.5 57.0	Fifty-fourth STS flight, piloted by Kenneth D. Cameron and Stephens S. Oswald. Payload Commander C. Michael Foale. Mission specialists Kenneth D. Cockerell and Ellen Ochoa. Launched from KSC 1:29 a.m., EDT. Landed at KSC 7:37 a.m., Apr. 17. Mission duration: 9 days, 6 hrs., 9 min.
Apr. 11 SPARTAN-201 23B	Objective: To study the velocity and acceleration of the solar wind and observe aspects of the Sun's corona. Spacecraft: Shuttle Point Autonomous Research Tool for Astronomy (SPARTAN-201), a free-flying payload with two telescopes, the White Light Coronagraph (WLC), and the Ultraviolet Coronal Spectrometer (UVCS).	311.0 295.0 90.3 57.0	Astronauts released the Spartan instruments platform from Discovery at 2:11 a.m., EDT and recovered it between 2:30 a.m. and 4:02 a.m., EDT, on Apr. 13.
Apr. 25 ALEXIS 26A Pegasus	Objective: To test technology for detecting ultra-soft x-rays emitted from space nuclear testing and to examine ionospheric distortion of	844.0 749.0 99.6 70.0	First such flight of an all-DoE sponsored satellite. It cost \$17 million for the satellite and its inte-

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	VHF radio signals. Spacecraft: Array of Low Energy X-ray Imaging Sensors (ALEXIS) Spacecraft, featuring a smaller, faster, and cheaper spacecraft bus, x-ray detectors, and a very high frequency receiver and digitizer.		grated components. In orbit.
Apr. 26 Space Shuttle Columbus (STS-55) 27A	Objective: To launch, operate and return Spacelab D-2, a German-sponsored payload for conducting microgravity research, to Earth. Spacecraft: Shuttle orbiter featuring a Spacelab long module with transfer tunnel, a unique support structure for mounting experiments outside the module, and the autonomous payload, Reaction Kinetics in Glass Melts-all to investigate material and life sciences, space technology, automation, and robotics. Secondary objective: Shuttle Amateur Radio Experiment II.	306.0 298.0 90.5 28.4	Fifty-fifth STS flight. Piloted by Steven R. Nagel and Terence T. Henricks. Mission specialists Jerry L. Ross, Charles J. Precourt, Bernard A. Harris, Jr. Payload specialists Ulrich Walter and Hans Schlegel. Launched from KSC 10:50 a.m., EDT. Landed at Edwards AFB, CA, 10:29 a.m., EDT, May 6, 1993. Mission duration: 9 days, 23 hrs., 39 min.
May 13 GPS USA 91 32A Delta II	Objective: To provide radio positioning and navigation, including position, velocity, and timing data to the DoD and civilian users. Spacecraft: A Block II satellite in the NAVSTAR Global Positioning System.	20,342.0 20,020.0 717.9 55.0	Twentieth in a series of operational GPS satellites. System expected to be composed of 24 satellites in inclined, semi-synchronous orbit. In orbit.
Jun. 21 Space Shuttle Endeavour (STS-57) 37A	Objective: To provide a platform for experiments on the SPACEHAB-1 payload and to retrieve the ESA's European Retrievable Carrier satellite deployed from Atlantis Aug. 2, 1992. There were also 7 secondary objectives, 16 developmental test objectives, and 11 detailed supplemental objectives. Spacecraft: Shuttle orbiter featuring SPACEHAB,	483.0 407.0 93.5 28.4	Fifty-sixth STS flight. Piloted by Ronald J. Grabe and Brian J. Duffy. Mission specialists G. David Low, Nancy J. Sherlock, Peter J.K. Wisoff, and Janice E. Voss. Launched from KSC 9:07 a.m., EDT. Recovered Eureka at 12:36 p.m., EDT Jun. 24.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
	a commercially developed, pressurized module that provides about 1,100 cu. ft. of additional pressurized volume to the Shuttle's habitable working space and supports primarily orbiter middeck-type experiments.		Landed at KSC 8:52 a.m., EDT, Jul. 1. Mission duration: 9 days, 23 hrs., 46 min.
Jun. 25 RADCAL 41A Scout	Objective: To provide space-based radar calibration for over 70 ground-based radars and to verify GPS use for satellite positioning. Spacecraft: Radar Calibration (RADCAL) experiment.	883.0 752.0 101.3 89.6	Twenty-second consecutive successful Scout launch. In orbit.
Jun. 26 GPS USA 92 42A Delta II	Objective: To provide radio positioning and navigation, including position, velocity, and timing data to DoD and civilian users. Spacecraft: A Block II satellite in the NAVSTAR Global Positioning System.	20,248.0 20,115.0 718.0 54.7	Twenty-first in a series of operational GPS satellites. System expected to be composed of 24 satellites in inclined semi-synchronous orbit. In orbit.
Jun. 26 Plasma Motor Generator 42B Delta II	Objective: To demonstrate the ability of a tether to generate an electrical current in space. Spacecraft: The tether consisted of two plasma contractors, or hollow cathode tubes, at either end of a 500-meter-long thin copper cable coated with teflon.	844.0 196.0 94.8 25.7	Launched from Cape Canaveral AFS 9:27 a.m. attached to second stage of Delta II. Decayed 30 August 1993.
Jul. 1 Soyuz TM-17			Crew consisted of Vasily Tsibliyev, Aleksandr Serebrov, and Jean-Pierre Haignere. Docked with Mir Space Station Jul. 3. Haignere returned to Earth with Soyuz TM-16. Serebrov, and Tsibliyev landed in TM-17 space craft after end of fiscal year on Jan. 14, 1994. Flight time: 196 days, 17 hrs., 45 min.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Jul. 19 DSCS III USA 93 46A Atlas II	Objective: To provide a world-wide, secure, uninterrupted communications capability in support of globally distributed DoD users. Spacecraft: Improved, third-generation Defense Satellite Communications System (DSCS) satellite.	35,743.6 35,743.6 1,440.0 0.0	Initial DSCS use of Atlas II launch booster coupled with an inertial upper stage for achieving Earth orbit. Satellite to be cut over to operational traffic in early FY 1994 in the West Pacific. In orbit.
Aug. 9 NOAA-13 50A Atlas E	Objective: To provide global environmental observation; land, sea, and air temperature, and moisture profiles; and to detect emergency beacons from ships and planes. Spacecraft: A 3-axis-stabilized, near-polar-orbiting satellite equipped with an Advanced Very High Resolution Radiometer, a High-resolution Infrared Sounder, a Solar Backscatter Ultraviolet Spectral Radiometer, plus Search and Rescue instruments provided by Canada and France among other equipment.	860.0 846.0 102.0 98.9	The purpose of the satellite was to replace the aging NOAA-11, but all communications with NOAA-13 ceased Aug. 21 and attempts to restore them have not been successful. In orbit.
Aug. 30 GPS USA-94 54A Delta II	Objective: To provide radio positioning and navigation, including position, velocity, and timing data to DoD and civilian users. Spacecraft: A Block II satellite in the NAVSTAR Global Positioning System.	20,257.0 20,109.0 718.0 59.0	Twenty-second in a series of operational GPS satellites. System expected to be composed of 24 satellites in inclined, semi-synchronous orbit. In orbit.
Sep. 3 UFO-2 USA-96 56A Atlas-Centaur 1	Objective: To provide communications and UHF links for the U.S. Navy, Strategic Command, and Army/Marine Rapid Deployment Forces. Spacecraft: Second of nine UHF satellites built for the Navy by Hughes Space and Communications Corp. to replace an aging Fleet Satellite Communications System.	36,446.0 35,140.0 1,436.5 5.1	Successfully launched into geosynchronous orbit and transitioned to normal operating mode with all systems nominal. In orbit.

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Sep. 12 Space Shuttle Discovery (STS-51) 58A	Objective: To deploy a satellite that will serve as a testbed for new communications satellite technology as well as to deploy and retrieve a U.S./German free-flying scientific observation satellite, among numerous other missions. Spacecraft: Shuttle orbiter with Advanced Communications Technology Satellite (ACTS), Orbiting and Retrieving Far and Extreme Ultraviolet Spectrometer-Shuttle Pallet Satellite (ORFEUS-SPAS), plus nine other cargo bay and in-cabin payloads.	307.0 275.0 90.3 28.4	Fifty-seventh STS flight. Piloted by Frank L. Culbertson, Jr., and William F. Readdy. Mission specialists James H. Newman, Daniel W. Bursch, and Carl E. Walz. Launched from KSC at 7:45 a.m., EDT. Landed at KSC 3:56 a.m., EDT, Sep. 22. Mission duration: 9 days, 20 hrs, 11 min.
Sep. 12 ACTS 58B	Objective: To flight test high-risk, advanced communications satellite technology for providing up to three times the communications capability for the weight of today's satellites, 20 times the rate of communications between users, and other advances over existing technology. Spacecraft: Basically rectangular satellite equipped with two solar arrays, a 30-GHz receiving antenna, a C-band omni antenna, a steerable antenna, and a 20-GHz transmitting antenna, among other equipment.	35,929.0 35,709.0 1,437.8 0.2	Deployed from Discovery at 5:13 p.m., EDT. Transfer Orbit Stage fired on time 45 min. later and boosted it to its planned orbit. Second mission of Transfer Orbit Stage and first use on a Shuttle mission. In orbit.
Sep. 13 ORFEUS- SPAS 58C	Objective: To investigate very hot and very cold matter in the universe using the retrievable ASTRO-SPAS spacecraft built by Germany. Spacecraft: ASTRO-SPAS containing the one-meter diameter ORFEUS-Telescope with the Far Ultraviolet Spectrograph and the Extreme Ultraviolet Spectrograph, plus the Interstellar Medium Absorption Profile Spectrograph and the Surface Effects Sample Monitor.	304.0 270.0 90.1 28.4	The Discovery crew released ORFEUS-SPAS on the morning of Sep. 13. Mission Specialist Dan Bursch recaptured the satellite at 7:50 a.m., EDT, on Sep. 19 using the Shuttle's robotic arm.

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Oct. 5 Landsat-6 63A Titan II	Objective: To monitor Earth resources in support of global change research, coastal zone monitoring, timber management, environmental monitoring, and other programs. Spacecraft: Landstat-6.	813.0 786.0 100.6 98.5	Satellite's kick motor failed to place it in final orbit, and communications with it ceased (i.e., launch was successful but not satellite).
Oct. 18 Space Shuttle Columbia (STS-58) 65A	Objective: To determine the effects of microgravity on human and animal subjects using the Spacelab Life Sciences-2 payload. Spacecraft: Shuttle orbiter carrying SLS-2.	291.0 282.0 90.2 39.0	Fifty-eighth flight of STS. Piloted by John E. Blaha and Richard A. Searfoss. Payload Commander M. Rhea Seddon, MD. Mission specialists Shannon W. Lucid, PhD; David A. Wolf, MD; William S. McArthur, Jr. Payload specialist Martin J. Fettman, DVM, PhD. Launched from KSC 10:53 a.m., EDT. Landed at Edwards AFB 11:22 a.m., EDT, Nov. 1.
Oct. 26 GPS 68A Delta II	Objective: To provide radio positioning and navigation, including position, velocity, and timing data to DoD and civilian users. Spacecraft: A Block IIA satellite in the NAVSTAR Global Positioning System.	20,268.0 20,093.0 717.9 55.2	Twenty-third in a series of operational GPS satellites. System to be composed of 24 satellites in inclined, semi-synchronous orbit. In orbit.
Nov. 28 DSCS III 74A Atlas II	Objective: To provide long-haul, high capacity communications system supporting the worldwide command and control of the U.S. Armed Forces and other Government agencies. Spacecraft: Improved, third-generation Defense Satellite Communications system (DSCS) satellite.	35,533.0 160.0 623.3 26.5	Cut over to operational traffic in mid-1994. In orbit

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Dec. 2 Space Shuttle Endeavour (STS-61) 75A	Objective: To restore the planned scientific capabilities and reliability of the Hubble Space Telescope and to validate the on-orbit servicing concept for HST. Spacecraft: Shuttle orbiter equipped with HST replacements.	594.0 588.0 96.5 28.4	Fifty-ninth flight of STS. Piloted by Richard O. Covey and Kenneth D. Bowersox. Mission specialists Tom Akers, Jeffrey A. Hoffman, Kathryn C. Thornton, Claude Nicollier (Switzerland), and F. Story Musgrave. Launched from KSC at 4:27 a.m., EST. Landed at KSC 26 minutes after midnight on Dec. 13. Mission duration: 10 days, 19 hrs., 58 Min.
Dec. 8 NATO IVB 76A Delta II	Objective: To provide secure and reliable military communications between NATO member nations and NATO military forces. Spacecraft: Military communications satellite built by British Aerospace.	35,914.0 762.0 644.5 23.3	Launched commercially by McDonnell Douglas. In orbit.
Dec. 16 Telstar 401 77A Atlas II	Objective: To provide television and data communications services for U.S. customers. Spacecraft: AT&T communications satellite.	35,804.0 188.0 631.2 23.9	Launched commercially by General Dynamics. In orbit.

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Jan. 8 Soyuz TM-18			Crew consisted of Viktor Afanasyev, Yuri Usachev, and Valery Polyakov. Docked with Mir Space Station Jan. 10. Afanasyev and Usachev landed in the TM-18 spacecraft on Jul. 9, 1994. Polyakov remained aboard Mir in the attempt to establish a new record for endurance in space. Flight time: 182 days, 27 min.
Jan. 25 Clementine 4A Titan II	Objective: To test in space 23 advanced technologies for high-tech, lightweight missile defense. Spacecraft: A deep space probe consisting of newly developed hardware, such as lightweight imaging sensors, all developed since 1990.	409,886.0 801.0 6,158.8 63.8	Conceived, built, and launched in 22 months, the satellite, whose position changed over the course of the year, also provided 1.8 million images of the surface of the Moon.
Feb. 3 Space Shuttle Discovery (STS-60) 6A	Objective: To deploy and retrieve a free-flying disk designed to generate new semiconductor films for advanced electronics and provide the second flight of a commercially developed research facility. Spacecraft: Shuttle orbiter carrying the Wake Shield Facility, a 12-foot-diameter, stainless steel disk, and SPACEHAB.	386.0 358.0 91.7 59.9	Sixtieth flight of the STS. Piloted by Charles F. Bolden and Kenneth S. Reightler, Jr. Mission specialists N. Jan Davis, PhD, Ronald M. Sega, PhD, Franklin R. Chang-Diaz, PhD, who also was payload commander, and Sergei Konstantinovich Krikalev (Russia), whose presence signified a new era in cooperation in space between the U.S. and Russia. Launched from KSC at 7:10 a.m., EST. Landed at KSC at 2:19 p.m., EST, Feb. 11. Mission duration: 8 days, 7 hrs., 9 min.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Feb. 7 Milstar 9A Titan IV	Objective: To begin a multi-channel, EHF/UHF satellite communications system providing survivable, enduring, and jam-resistant secure voice data communication for the Armed Forces and other users. Spacecraft: A communications satellite using extremely high-frequency radio and encryption technology to prevent jamming.	Not announced.	Launch included first use of Titan IV with Centaur upper stage. First Milstar satellite. In orbit.
Feb. 9 ODERACS 6B-6G Space Shuttle	Objective: To improve the ability of ground-based radars to detect and track small debris objects. Spacecraft: Six spheres ranging in diameter from two to six inches.	Elements vary.	Deployed from the orbiter's payload bay. In orbit at end of FY but ODERACS A & B (COSPAR designations 6B & 6C) decayed Oct. 2 & 4 respectively.
Feb. 9 BREMSAT 6H Space Shuttle Discovery	Objective: To study various phenomena in space including heat conductivity, the forces of acceleration, and atomic forces. Spacecraft: The University of Bremen Satellite, built by that institution's Center of Applied Space Technology and Microgravity. Weight: 140 lbs. (63 kg.); length: 19" (480 mm).	320.0 302.0 90.8 57.0	Spring-ejected from its canister in the orbiter's bay. In orbit.
Feb. 19 Galaxy 1R 13A Delta II	Objective: To provide video communications. Spacecraft: A geostationary communication satellite with 24 C-band transponders, owned by Hughes Communications, Inc.	37,300.0 2,933.0 715.3 25.1	Launched commercially by McDonnell Douglas. In orbit.
Mar. 9 Space Shuttle Columbia (STS-62) 15A	Objective: To conduct dozens of experiments in such areas as materials processing, biotechnology, advanced technology, and environmental monitoring. Spacecraft: Shuttle orbiter	309.0 296.0 90.4 39.0	Sixty-first flight of the STS. Piloted by John H. Casper and Andrew M. Allen. Mission specialists Pierre J. Thuot, Charles D. Gemar, and

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	equipped with the U.S. Microgravity Payload-2, the Office of Aeronautics and Space Technology-2, the Shuttle Solar Backscatter Ultraviolet instrument, and other payloads.		Marsha S. Ivins. Launched from KSC at 8:53 a.m., EST. Landed at KSC 8:10 a.m., EST, Mar. 18. Mission duration: 13 days, 23 hrs., 17 min.
Mar. 10 GPS 16A Delta II	Objective: To provide radio positioning and navigation, including position, velocity, and timing data to DoD and civilian users. Spacecraft: A Block II satellite in the NAVSTAR Global Positioning System.	20,348.0 20,016.0 718.0 55.0	Twenty-fourth and final satellite in the GPS constellation. In orbit.
Mar. 10 SEDS-II 16B Delta II	Objective: To suspend a tether in space with a minimum of swing and to determine the resistance of its braided polyethylene to micrometeoroids, space debris, and atomic oxygen. Spacecraft: A 23-kilogram mini-satellite.	358.0 344.0 91.3 32.3	Ejected by the Delta's second stage using a spring-loaded device. At 20 kilometers, the longest object ever placed in space. Severed on Mar. 15, but the remaining 10-12 kms. remained attached to the rocket's second stage until it decayed May 8.
Mar. 13 ARPASAT 17A Taurus	Objective: To demonstrate a low-cost, classified space capability, validate advanced technologies, and assess the operational utility of direct user tasking and collection of payload data. Spacecraft: A 400-lb satellite developed by Ball Aerospace Corporation for the Advanced Research Projects Agency of DoD.	Not announced.	Launched by the first Taurus standard small launch vehicle. In a 290-nautical-mile, 105-degree-inclination orbit.
Mar. 13 STEP-TAOS 17B Taurus	Objective: To demonstrate and validate state-of-the-art spacecraft technologies to ensure	Not announced.	Launched by the first Taurus standard small launch vehicle. In a

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	autonomy and survivability in an operational space environment. Spacecraft: Space Test Program Experimental Platform Technology for Autonomous Operational Survivability, also known as STEP-0.		290-nautical-mile, 105-degree-inclination orbit.
Mar. 13 Not announced 17C-17J	Objective: Not announced. Spacecraft: Not announced.	Not announced.	In orbit.
Apr. 9 Space Shuttle Endeavour (STS-59) 20A	Objective: To gather Earth images from Space Radar Laboratory-1 to improve the understanding of our planet's carbon, water, and energy cycles and the effects humans have on them. Spacecraft: Shuttle orbiter carrying SRL-1 and other payloads.	218.0 204.0 88.7 56.9	Sixty-second flight of the STS. Piloted by Sidney M. Guthierrez and Kevin P. Chilton. Mission specialists Jerome Apt, Michael R. Clifford, Linda M. Godwin (also payload commander), and Thomas D. Jones. Launched from KSC at 7:05 a.m., EDT. Landed at EAFB at 12:54 p.m., EDT, on Apr. 20. Mission duration: 11 days, 5 hrs., 50 min.
Apr. 13 GOES-8 22A Atlas I	Objective: To provide more precise and timely weather observation and data on the atmosphere. Spacecraft: Geostationary Operational Environmental Satellite-8 with three-axis stabilization to permit continuous observation of Earth.	35,805.0 35,773.0 1,436.2 0.2	Satellite positioned at 90 degree West Longitude during checkout, but plans called for it to be moved to 75 degree West Longitude once it became operational. In orbit.
May 3 DSP 26A Titan IV	Objective: To provide DoD with enhanced missile warning and surveillance capabilities. Spacecraft: The 17th Defense Support Program satellite in geostationary orbit.	Not announced.	In orbit.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
May 9 MSTI-2 28A Scout	Objective: To provide ballistic missile launch detection and environmental/ecological monitoring. Spacecraft: Miniature Sensor Technology Integration-2 satellite with short-wave infrared sensors.	433.0 415.0 93.1 97.1	Launched by the last Scout into Sun-synchronous orbit.
May 19 STEP-2 29A Pegasus	Objective: To evaluate unusual detection techniques for the DoD so as to separate adjacent, overlapping co-channel communications transmitted at a low signal level. Spacecraft: Space Test Program Experimental Platform.	817.0 600.0 99.0 82.0	In orbit.
Jun. 24 UFO-3 35A Atlas I	Objective: To provide UHF communications for DoD. Spacecraft: Third Ultra High Frequency Follow-on satellite built by Hughes Aircraft Company for the Navy to replace the FLTSATCOM system.	15,457.0 383.0 283.6 27.1	First Asian launch conducted by Martin Marietta following its purchase of the Atlas business from General Dynamics. In orbit. Became operational over the Atlantic Ocean in October 1994.
Jul. 1 Soyuz TM-19			Crew consisted of Yuri Malenchenko and Talgat A. Musabayev. Docked Mir Space Station Jul. 3. Both Malenchenko and Musabayev returned to Earth with the Soyuz-TM 19 spacecraft, landing in Kazakhstan on Nov. 4, together with Ulf Merbold of Germany, who went up aboard Soyuz TM-20 on Oct. 3, 1994. Merbold gathered biological samples on the effect of weightlessness on human body in the first of the two ESA mis-

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
			sions to Mir to prepare for the international Space Station. Flight time: 125 days, 22 hrs., 53 min.
Jul. 8 Space Shuttle Columbia (STS-65) 39A	Objective: To conduct research into the behavior of materials and life in the nearly weightless environment of low Earth orbit. Spacecraft: Shuttle orbiter equipped with the International Microgravity Laboratory-2 and other payloads.	304.0 300.0 90.5 28.4	Sixty-third flight of the STS. Piloted by Robert D. Cabana and James D. Halsell, Jr. Mission specialists Richard J. Hieb (also payload commander), Carl E. Walz, Leroy Chiao, PhD, and Donald A. Thomas, PhD. Payload specialist Chiaki Noto-Mukai, MD, PHD (Japan). Launched from KSC at 12:43 p.m., EDT. Landed at KSC on Jul. 23 following a record duration flight of 14 days, 17 hrs., 55 min.
Aug. 3 APEX 46A Pegasus	Objective: To test the impact of radiation in the Van Allen belt on two target instruments. Spacecraft: Advanced Photovoltaic Experiment, a test spacecraft carrying three diagnostic instruments.	2,538.0 362.0 114.9 70.0	Pegasus launch vehicle carried by a B-52 bomber that took off from EAFB. In orbit.
Aug. 3 DBS-2 47A Atlas IIA	Objective: To provide commercial television service to the 48 contiguous states in the United States. Increase channel capacity from DBS-1 (alone) to 150 channels. Spacecraft: Geostationary communications satellite owned by DirecTV and United States Satellite Broadcasting. Named Direct Broadcast Satellite-2 or DIRECTV-2.	39,445.0 196.0 703.4 26.9	Launched commercially by Martin Marietta. In orbit.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Aug. 27 USA 105 54A Titan IV	Objective: Classified DoD mission. Spacecraft: Not announced.	Not announced.	In orbit along with 54B, about which no information is available.
Aug. 29 DMSP F-12 57A Atlas E	Objective: To provide specialized meteorological data in support of DoD operations, including cloud coverage, wind speed, and precipitation. Spacecraft: Defense Meteorological Satellite Program Satellite F-12 (indicating the 12th satellite in Block 5D) with eight sensors to measure ocean surface wind speed, areas and intensity of precipitation, cloud water content, land surface moisture, and space environmental data.	856.0 838.0 101.9 98.9	In orbit.
Aug. 29 Not announced 57B-57E	Objective: Not announced. Spacecraft: Not announced.	Elements vary.	In orbit.
Sep. 9 Space Shuttle Discovery (STS-64) 59A	Objective: To perform atmospheric research using a laser, conduct robotic processing of semi-conductor materials, deploy and retrieve a free-flying astronomical sub-satellite, and perform the first untethered spacewalk by astronomers in over ten years. Spacecraft: Shuttle orbiter equipped with LIDAR In-Space Technology Experiment, the Robot Operated Processing System, Shuttle Pointed Autonomous Research Tool, and Simplified Aid for EVA (Extra Vehicular Activity) Rescue, among other items.	269.0 259.0 89.5 56.9	Sixty-fourth flight of the STS. Piloted by Richard N. Richards and L. Blaine Hammond, Jr. Mission specialists J. M. Linenger, MD, PhD, Susan J. Helms, Carl J. Meade, and Mark C. Lee. Launched at 6:23 p.m., EDT, and landed at 5:13 EDT, at EAFB on Sep. 20. Mission duration: 10 days, 22 hrs., 50 min.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Sep. 13 SPARTAN-201 59B Space Shuttle Discovery	Objective: To explain how the solar wind is generated by the Sun. Spacecraft: Shuttle Pointed Autonomous Research Tool-201, a battery-powered sub-satellite equipped with a pointing system and recorder for capturing data about the acceleration and velocity of the solar wind plus aspects of the Sun's corona.	50 minutes behind Discovery	Released from Discovery's payload bay and recovered on Sep. 15.
Sep. 30 Space Shuttle Endeavour (STS-68) 62A	Objective: To re-fly the Space Radar Laboratory and provide scientists with detailed information to help distinguish between human-induced environmental changes and other natural forms of change. Spacecraft: Shuttle orbiter equipped with Space Radar Laboratory-2, Get Away Special experiments, and a number of in-cabin payloads.	226.0 213.0 88.9 57.0	Sixty-fifth flight of STS. Piloted by Michael A. Baker and Terrence D. Wilcutt. Commander and Mission Specialist Thomas D. Jones. Mission specialists Steven L. Smith, Daniel W. Bursch, and Peter J. K. Wisoff. Launched (after an initial abort on Aug. 18) at 7:16 a.m., EDT, from Cape Canaveral. Landed at EAFB on Oct. 11.
Oct. 3 Soyuz TM-20		35,803.0 35,755.0 1,436.0 0.04	Crew consisted of Aleksandr Viktorenko, Telena Kondakova, and Ulf Merbold (USA). Soyuz TM-19 returned to Earth on Nov. 4, with Yuri Malenchenko, Talgat Musabayev, and Ulf Merbold. Valery Polyakov remained aboard Mir.
Oct. 6 Intelsat 703 64A Atlas IIAS	Objective: To provide television and telephone service for N. Pacific region.		

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Nov. 1 Wind 71A Delta II	Objective: To measure solar wind plasma and magnetic field.	Variable parameters.	Part of GGS/ISTP program.
Nov. 3 Space Shuttle Atlantis (STS-66) 73A	Objective: To collect tempera- ture and solar energy data for NASA and NOAA.	310.0 296.0 91.0 57.0	Deployed Atlas-3, SSBUV, and CRISTA- SPAS-1 payloads.
Nov. 29 Orion 79A Atlas IIA	Objective: To provide television service.	36,022.0 35,621.0 1,438.0 30.0	German spacecraft.
Dec. 22 DSP-17 (USA-107) 84A Titan IV	Objective: To provide early warning missile launch detec- tion.	Geosynchro- nous. Exact parameters not available.	
Dec. 30 NOAA-14 (NOAA-J before orbit) 89A Atlas E	Objective: To measure weather data, such as atmospheric tem- perature and moisture.	858.0 845.0 102.0 98.9	Replaced NOAA-11.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Jan. 10 Intelsat 704 1A Atlas IIAS	To provide radio and television coverage for Middle East, Africa, and Europe.	35,797.0 35,776.0 1,436.0 0.02	
Jan. 28 EHF-F4 (UFO-4) (USA-108) 3A Atlas II	To provide naval communications.	36,388.0 24,474.0 1,171.0 5.4	DoD payload on commercial ELV. First UHF Follow-On to carry EHF package.
Feb. 3 Space Shuttle Discovery (STS-63) 4A	First close encounter in nearly 20 years between U.S. and Russian spacecraft (Mir); prelude to international Space Station.	342.0 310.0 91.0 51.6	Carried SPARTAN 204, SSCE, and AMOS payloads.
Feb. 7 SPARTAN 204 4B STS-63	Far-ultraviolet spectrograph saw galactic dust clouds.	Similar to STS-63.	Shuttle Pointed Autonomous Research Tool for Astronomy.
Feb. 7 ODERACS 2A-2E 4C-4G STS-63	Provide calibration for radar echoes.	Similar to STS-63.	Very small Orbital Debris Radar Calibration Spheres.
Mar. 2 Space Shuttle Endeavour (STS-67) 7A	First ultraviolet images of the Moon taken by ASTRO-2 (trio of ultraviolet telescopes).	363.0 349.0 91.0 28.5	Also conducted protein crystal growth experiment.
Mar. 14 Soyuz TM-21			Crew consisted of Vladimir Dezhurov, Gennadi Strekalov, and Norman Thagard (USA). Thagard was first American astronaut to fly on a Russian rocket and to stay on the

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
			Mir Space Station. Soyuz TM-20 returned to Earth on Mar. 22, 1995, with Valery Polyakov, Aleksandr Viktorenko, and Yelena Kondakova. Polyakov set world record by remaining in space for 438 days.
Mar. 22 Intelsat 705 13A Atlas IAS	To provide telecommunications for Latin America.	35,800.0 35,776.0 1,436.0 0.04	
Mar. 24 Defense Meteorological Satellite Program DMSP/F13 (USA-109) 15A Atlas E	To replenish DoD meteorologi- cal constellation.	854.0 847.0 102.0 98.8	Final Atlas E launch.
Apr. 3 Orbcomm 1 & 2 17A & 17B Pegasus	To provide global paging and data communication.	747.0 734.0 100.0 69.9	First of 26 planned satellites.
Apr. 3 Microlab 1 17C Pegasus	Microsatellite with global light- ning mapper and GPS radio receiver.	747.0 734.0 100.0 69.9	
Apr. 7 MSAT (AMSC-1) 19A Atlas IIA	To provide mobile telephone communication.	Geosynchro- nous. Exact parameters not available.	American Mobile Satellite Corp.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
May 14 DoD classified payload (USA-110) 22A Titan IV	To provide electronic intelligence.	Parameters not available.	
May 23 GOES-9 (GOES-J) 25A Atlas I	Image cloud cover; measure atmospheric temperature and moisture.	35,806.0 35,775.0 1,436.0 0.07	Replaced GOES-7 over west coast of the United States.
May 31 EHF-F5 (UFO-5) (USA-111) 27A Atlas II	To provide naval communication.	Geosynchronous. Exact parameters not available.	DoD payload on commercial ELV.
Jun. 25 Space Shuttle Atlantis (STS-71) 30A	To rendezvous with Mir Space Station.	385.0 296.0 91.0 51.6	Brought up Mir 19 crew; returned Mir 18 crew to Earth.
Jul. 10 DoD classified payload (USA-112) 34A Titan IV	To provide signal intelligence.	39,200.0 1,300.0 720.0 64.0 (Data estimated by Jane's Intelligence Review)	
Jul. 13 Space Shuttle Discovery (STS-70) 35A	To deploy Tracking and Data Relay Satellite (TDRS).	315.0 287.0 91.0 28.4	First Shuttle mission to use new Mission Control Center in Houston.

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Jul. 13 TDRS-7 35B STS-70	To tracking and Data Relay Satellite (TDRS) for other spacecraft and ground in F and Ku bands.	35,803.0 35,773.0 1,436.0 0.43	
Jul. 31 Defense Satellite Communications System (DSCS-III) (USA 113) 38A Atlas IIA	To provide military communica- tion.	Geosynchro- nous. Exact parameters not available.	
Aug. 5 Koreasat 41A Delta II	To provide South Korea televi- sion.	29,798.0 26,777.0 1,062.0 0.07	Failed to reach geosta- tionary orbit initially.
Aug. 28 JCSat3 43A Atlas IIA	To carry voice, data, and digital television signals.	Geosynchro- nous. Exact parameters not available.	Japan's first regional communications spacecraft.
Sep. 3 Soyuz TM-22			Crew consisted of Yuri Gidzenko, Sergei Avdeyev, and Thomas Reiter (ESA). Soyuz Tm-21 returned to Earth on Sep. 11, 1995, with Mir 19 crew (Anatoliy Solovyev and Nikolay Budarin).
Sep. 7 Space Shuttle Endeavour (STS-69) 48A	To deploy SPARTAN and Wake Shield Facility.	-370.0 91.0 28.4	

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Sep. 8 SPARTAN 201 48B STS-69	To provide X-ray, far-ultraviolet, and visible instruments to study solar corona and galactic clusters.	Parameters similar to STS-69.	
Sep. 11 Wake Shield Facility (WSF-2) 48C STS-69	Grow special semiconductors.	Parameters similar to STS-69.	Terminated early because of overheating.
Oct. 20 Space Shuttle Columbia (STS-73) 56A	To carry out microgravity experi- ments in the U.S. Microgravity Laboratory Spacelab.	-267.0 90.0 39.0	
Oct. 22 EHF-F6 (USA 114) (UFO-6) 57A Atlas II	To deploy military UHF commu- nications.	27,571.0 277.0 479.0 27.0	
Nov. 4 RADARSAT 59A Delta II	Remote sensing.	790.0 785.0 101.0 98.6	Canadian spacecraft.
Nov. 4 SURFSAT 59B Delta II	Summer undergraduate Research Fellowship Satellite.	1,495.0 935.0 110.0 100.6	Microsatellite to assist tests of Deep Space Network. Launched from second stage of Delta II.
Nov. 6 Milstar 2 (USA 115) 60A Titan IV	To provide military communica- tions.	Geosynchro- nous.	

Launch Date (GMT), Spacecraft Name, COSPAR Designation, Launch Vehicle	Mission Objectives, Spacecraft Data	Apogee and Perigee (km), Period (min.) Inclination to Equator (°)	Remarks
Nov. 12 Space Shuttle Atlantis (STS-74) 61A	To install Docking Module on the Mir Space Station and pro- vide logistic support.	396.0 391.0 92.0 51.6	Second of 9 planned flights to Mir.
Dec. 2 SOHO 65A Atlas Centaur IIAS	To provide solar and Heliospheric Observatory on space physics mission.	Orbits the Sun.	European Space Agency- NASA spacecraft to examine the Sun and its corona.
Dec. 5 USA 116 66A Titan IV	Classified <i>military reconnais- sance.</i>	976.0 156.0 96.0 97.8 (data estimated by Itar-Tass agency).	Reported to be member of Keyhole constellation.
Dec. 14 Galaxy 3-R 69A Atlas IIa	To provide commercial commu- nications satellite.	Geosynchro nous.	
Dec. 30 RXTE 74A Delta II	Rossi X-ray Timing Explorer, an astrophysics mission.	583.0 565.0 96.0 22.9	

Appendix B

ABBREVIATION OF REFERENCES

Listed here are the abbreviations used for citing sources in the text. Not all the sources are listed, only those that are abbreviated.

Aero Space Rep Pres	Aeronautics and Space Report of the President
AFP	Agence France Presse
AP	Associated Press new service
ARC Release	NASA Ames Research Center news release
<i>AvWk</i>	<i>Aviation Week & Space Technology</i> magazine
<i>B Sun</i>	<i>Baltimore Sun</i> newspaper
<i>Bus Wk</i>	<i>Business Week</i> magazine
<i>C Trin</i>	<i>Chicago Tribune</i> newspaper
CSM	<i>Christian Science Monitor</i> newspaper
<i>D News</i>	<i>Detroit News</i> newspaper
<i>Def News</i>	<i>Defense News</i>
FBIS-Chi	Foreign Broadcast Information Service, Chinese number
FBIS-Eas	Foreign Broadcast Information Service, Eastern Europe number
FBIS-Lat	Foreign Broadcast Information Service, Latin American number
FBIS-Nes	Foreign Broadcast Information Service, Near East number
FBIS-Sov	Foreign Broadcast Information Service, Soviet number

FBIS-Weu	Foreign Broadcast Information Service, Western Europe number
<i>Fla Today</i>	<i>Florida Today</i> newspaper
GSFC Release	NASA Goddard Space Flight Center news release
<i>H Chron</i>	<i>Houston Chronicle</i> newspaper
<i>H Post</i>	<i>Houston Post</i> newspaper
<i>Htsvl Tms</i>	<i>Huntsville Times</i> newspaper
JPL Voyager Status Report	NASA Jet Propulsion Laboratory, Voyager Status Report
JSC Release	NASA Lyndon B. Johnson Space Center new release
<i>LA Herald</i>	Los Angeles <i>Herald-Examiner</i> newspaper
<i>LA Star News</i>	Los Angeles <i>Star News</i> newspaper
<i>LA Times</i>	<i>Los Angeles Times</i> newspaper
LRC Release	Langley Research Center news release
<i>M News</i>	<i>Miami News</i> newspaper
MSFC Release	NASA George C. Marshall Space Flight Center news release
NASA anno	NASA announcement
NASA DAR	NASA Daily Activities Report
NASA MOR	NASA Headquarters Mission Operations Report, preliminary launch and postlaunch report series
NASA PFOR	NASA Post-Flight Operations Report
NASA Release	NASA Headquarters news release

NASA spl anno	NASA special announcement
Nat Sp Trans Sys	National Space Transportation Critical Items List
<i>NY Times</i>	<i>New York Times</i> newspaper
<i>O Sen Star</i>	<i>Orlando Sentinel Star</i> newspaper
<i>P Inq</i>	<i>Philadelphia Inquirer</i> newspaper
Reuters	Reuters Press Agency
<i>Science</i>	<i>Science</i> magazine
<i>SF Chron</i>	<i>San Francisco Chronicle</i> newspaper
<i>SP News</i>	<i>Space Propulsion</i> newsletter
SSR	NASA Satellite Situation Report
<i>Tor Star</i>	<i>Toronto Star</i> newspaper
UPI	United Press International news service
<i>USA Today</i>	<i>USA Today</i> newspaper
<i>W Post</i>	<i>Washington Post</i> newspaper
<i>W Times</i>	<i>Washington Times</i> newspaper
WH Release	White House news release
WSJ	<i>Wall Street Journal</i> newspaper

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