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HIGHLIGHTS OF 1979 ACTIVITIES: YEAR OF THE PLANETS

The closing year of the seventies was a triumphant one in U.S. space exploration, yielding historic and breath-taking closeup views of distant planets, moons and rings.

The excitement of 1979's planetary discoveries was interrupted briefly, in mid-year by a returning hulk -- Skylab. And even that went well, the Earth-orbiting experimental space station completing its atmospheric reentry and breakup without damage or injury.

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The agency also had a perfect launch record in 1979, the second year in a row and the fourth in its 21-year history. The nine NASA launches for the year covered the gamut from high energy astrophysics, communications and cosmic ray particles to data on aerosols and ozone in the Earth's atmosphere.

Other NASA highlights in 1979 included continuing work, with some problems, on Space Shuttle development; a U.S./China agreement on cooperation in science and technology; expanded applications of space technology; continuing work on safer more efficient aircraft.

Space Science

This was the year of the planets in space exploration. The first high-resolution pictures of Jupiter and five of its satellites were received from Voyagers 1 and 2 in March and July using two onboard, slow-scan TV cameras. Pioneers 10 and 11 had taken pictures of the planet in 1973 and 1974, but not of the same quality.

Several weeks after the second Voyager flew by Jupiter, Pioneer 11 sped under the rings of Saturn, taking pictures of the planet and it's Mercury-sized moon, Titan. These were the first closeup pictures even taken of Saturn, the most distant planet yet reached in the exploration of the solar system.

The Voyager encounters were the most remarkable planetary flybys of this year or any other year. Not only did the two spacecraft return the best imagery ever received of the gaseous planet, showing in detail the dynamic behavior of the Jovian atmosphere, but they also discovered:

- A 14th moon orbiting the planet.
- A previously unknown Jovian ring.
- The inner Galilean moon, Io, is by far the most volcanically active member of the solar system.
- The two outer Galilean moons, Ganymede and Callisto, have a substantial amount of water ice, heavily cratered surfaces and there are indications of tectonic plate motion on Ganymede.
- Europa is a smooth satellite with no remains of early bombardment (craters) but it does have hugh global-scale linear, crustal features -- some over 1,000 kilometers (600 miles) long by 200-300 km (120-180 mi.) wide -- indicating a young warm surface.

Pioneer 11 found that Saturn consists of liquid metallic hydrogen, has an 11th moon, a magnetic field, radiation belts and two previously undetected rings, but no evidence of an innermost D ring or an expected outer E ring. In addition, measurements indicate that Saturn's rings are made largely of ice and that radiation belts are completely eliminated by the rings -- the most radiation-free area in the solar system.

Saturn cloud tops exhibit few details, unlike those of Jupiter, and overall the planet appears to have more and narrower belts and zones than Jupiter. The upper atmosphere was warmer than expected and the planet was found to radiate 2.5 times more heat into space than it received from the Sun.

As for the planet-sized satellite, Titan, Pioneer 11 showed it has extremely low cloud top temperatures of -198 C (-324 F.), thus eliminating an internal heat source to warm its surface and limiting the chance that life could exist there.

While Pioneer 11 was making its epic visit to Saturn, Pioneer 10 continued its journey out of the solar system, having passed the orbit of Uranus in July. The two Pioneers, like the two Voyagers, eventually will pass out of the solar system into interstellar space.

Pioneer Venus, launched in 1978, continued its successful mission. Probes were dispatched from the spacecraft as it approached the planet and measured the atmosphere as they plunged to the surface. In December last year, the orbiter was successfully inserted into orbit. As data returned to Earth over the next few months, more was learned about the planet than had ever been known before.

It was found that the surface of Venus is unlike any other planet in the solar system. It has huge mountains, great plateaus, deep rifts and circular features that appear to be impact craters made early in its history.

Elsewhere in the solar system, on Mars, three years after two Viking orbiters and landers successfully began transmitting information from the planet, one orbiter continues to transmit pictures back to Earth and to relay data from Lander 2. As the attitude control gas on the Viking orbiter approaches depletion, both the orbiter and Lander 2 will cease functioning, leaving only Lander 1 operating. It can transmit directly to Earth and has been programmed to do so for the next 10 years.

As the year ended, NASA told Congress that its plans for a 1982 mission to Jupiter, Galileo, have been postponed. Tentatively now two spacecraft will be launched in 1984 aboard two Space Shuttle flights instead of a single Shuttle launch in 1982 that would carry one spacecraft which would separate into an orbiter and an atmospheric probe.

In astronomy, the High Energy Astronomy Observatory continued to return fascinating new results from Earth orbit and a third spacecraft, HEAO-3, was placed in orbit in September.

HEAO-2 returned new data on supernova remnants and binary systems which consist of a normal star and a highly dense companion which might be a neutron star or the theoretical black hole. A black hole is believed to be so dense that not even light can escape its gravitational pull.

Based on the results of the HEAO data, it is expected that scientists will better understand how heavy elements are created in such super star explosions and provide more information on the physical processes within and around neutron stars. In addition, it is believed that with more detailed observations of this type the chances for coming up with direct evidence for the existence of black holes is greatly advanced.

For example, HEAO observations of a quasar showed that its X-ray intensity decreased sharply in less than two hours, implying that the X-ray emitting component must be both extremely compact and massive. The theoretical object that could produce the tremendous energy measured from quasars (the equivalent of ten thousand billion Suns) would be an enormous black hole. In this case, it would be approximately two billion times the mass of the Sun.

Space Transportation System

Space Shuttle orbiter Columbia, the external tank, and all components of the solid rocket boosters were delivered to the Kennedy Space Center, Fla., this year in preparation for the historic first launch of the spacecraft in 1980.

The Columbia was "piggybacked" to Kennedy aboard its Boeing 747 carrier aircraft in March from NASA Dryden Flight Research Center, Edwards, Calif., after an overland move from the Rockwell International Corp. plant at Palmdale, Calif.

Progress in processing the Columbia has shown steady improvement since mid-year. Over 10,000 thermal protection tiles have been installed since March and the first three flight engines have been installed while the Columbia has been quartered in the Orbiter Processing Facility.

Main engine testing and installation and integrity of the thermal protection system have been the pacing items in preparing the Columbia for its first test flight.

Over 52,000 test seconds have been logged on the Space Shuttle main engine toward the 80,000 seconds of test firings planned before the first orbital flight.

A main fuel valve failure in July and the rupture of an engine nozzle hydrogen line in October during main propulsion test firings caused two delays in three-engine cluster firing tests. The firings were scheduled to resume near the end of the year.

Previous main engine development problems have been overcome and minor turbine pump problems are being solved.

Extensive laboratory testing coupled with wind tunnel and aircraft flight testing has been conducted during 1979 to better understand the structural integrity of the thermal tile. As a result of analysis and testing a major effort to improve the bonding of the tile to the spacecraft and subsequent development of a higher strength tile has occurred. More than half of the 31,000 tiles will be "pull-tested" and rebonded if the tiles do not pass the more critical strength test.

With nearly all major flight elements in place at Kennedy and facility construction done, facility verification testing was completed, using the orbiter Enterprise and other full-scale elements.

The Enterprise was returned piggyback to the West Coast after the tests. Enroute to California, stops in several cities across the country were made and more than 800,000 persons viewed the Enterprise up close.

Extensive testing on the orbiter structural test article was completed at the Lockheed Test Facility at Palmdale, Calif. With the testing completed, the spacecraft will be reworked to flight configuration. These modifications will convert the test article into the second flight orbiter, the Challenger.

In April 1979, the European Space Agency delivered a second Spacelab pallet to Kennedy. The two pallets will carry payloads on Space Shuttle orbital flight tests scheduled in 1980 and 1981.

In Bremen, Germany, initial assembly of the first Spacelab flight unit is in progress with testing expected to start soon. The Spacelab is funded and built by the European Space Agency. The first Spacelab flight is scheduled for 1982.

Firm commitments have been received from users for the first three years of Shuttle operations and negotiations continued through 1979 to reach launch service agreements with a variety of users, both commercial and foreign.

NASA is committed to an orderly transition from expendable launch vehicles to the use of the Shuttle. In June 1979, NASA published a proposed transition policy in the Federal Register that extended the transition period through 1982 for both Delta and Atlas Centaur class payloads.

NASA's Scout, Delta, Atlas Centaur and Atlas-F expendable launch vehicles successfully placed nine spacecraft into orbit during 1979. Three were NASA missions; the Stratospheric Aerosol and Gas Experiment launched by a Scout rocket; the High Energy Astronomy Observatory launched by an Atlas Centaur and Magsat, an applications satellite launched aboard a Scout. The six reimbursable launches were: a United Kingdom (UK-6) scientific satellite; a domestic communications satellite for Western Union (Westar-3); a Defense Department communications satellite (FLTSATCOM-B); and a technology satellite (SCATHA) a weather satellite for the National Oceanic and Atmospheric Administration; and a commercial communications satellite (RCA-C). Contact was lost with the last satellite while RCA was changing its orbit.

Astronaut Program

The NASA Lyndon B. Johnson Space Center, Houston, received more than 3,000 applications for Space Shuttle astronaut candidates in a two-month recruiting drive that ended Dec. 1.

A total of 2,937 men and women applied for the 10 to 20 open astronaut positions, with 341 of these applying for both pilot and mission specialist categories.

The number of women applicants for the two categories totaled 390.

The astronaut selection board at Johnson will narrow the field to those best qualified in the two categories. From these, approximately 100 will be selected for preliminary screening and physicals at Johnson in the spring of 1980. Those selected as astronaut candidates will report in July 1980 for their one-year training and evaluation period.

NASA plans to accept applications for Space Shuttle astronauts on an annual basis. The number of open positions will depend on NASA's need for pilots and mission specialists.

Earlier in the year, 35 astronaut candidates completed their training at Johnson and joined 27 other astronauts in preparing for the Space Shuttle flights.

Skylab

Skylab, the 77.5-ton space station launched on May 14, 1973, to serve as home to three crews of astronauts for varying periods of time in 1973 and 1974, kept the world on tenterhooks right to the end.

In its operational lifetime, nearly 300 scientific and technical investigations were performed aboard the workshop: medical experiments on man's adaptation to zero gravity; intensive studies of the Sun, with a major scientific accomplishment in the monitoring of a solar flare; and detailed Earth resources experiments.

In the closing days of the reentry, a round-the-clock watch was set up at NASA Headquarters in Washington, with crews ready to go anywhere in the world if necessary to handle emergency conditions.

From across the country and around the world, press and public attention was riveted on the reentry and its possible risk to heavily populated regions. NASA Headquarters hosted perhaps the biggest concentration of news media representatives ever gathered there. Also on hand, or on standby, were representatives of the White House, the Federal Preparedness Agency and the departments of State, Justice, Transportation and Defense.

In Skylab's final few minutes of life, on July 11, the spacecraft overshot somewhat its predicted target in the ocean, dropping debris in the Indian Ocean and in Australia's Outback.

In the follow-up, a NASA team traveled to Australia and gathered some samples of the debris for study.

Reentry of a smaller spacecraft, the 10,400-kilogram (23,000-pound) Pegasus 2, stirred much less interest and came down without incident Nov. 3 in the Atlantic Ocean about 800 miles southwest of the Cape Verde Islands.

Energy Programs

NASA's goal is to support national energy needs through the effective application of space agency capabilities.

NASA work, sponsored by the Department of Energy and other agencies, encompasses a variety of projects including solar cell power systems, automotive power systems, industrial gas turbine development, solar heating and cooling, wind turbine generators, solar thermal electric conversion, energy storage and advanced coal extraction and processing.

Other efforts include satellite power systems, nuclear waste management in space, fuel cell systems and magneto-hydrodynamics.

This year, an advanced, experimental electric passenger car, with a top speed of 105 kilometers per hour (65 miles per hour) and a range of 193 km (120 mi.) was designed and developed under NASA direction by a General Electric/Chrysler team as one element of the Energy Department's Electric and Hybrid Vehicle Program. NASA is currently conducting extensive tests and evaluations with the vehicle, designated ETV-1.

Four new gas-turbine powered intercity buses were placed in regular route service in a three-year Energy Department/NASA/Greyhound Lines test program aimed at using energy efficient advanced engines for public transportation. Other advantages of heavy-duty gas-turbine engines include lower maintenance time and cost, easier starts in cold weather, reduced exhaust emissions, improved reliability and comfort and the option of running on synthetic and non-petroleum based fuels.

Solar electric power now pumps water and mills grain in the west African village of Tangaye, Upper Volta, in a joint Agency for International Development/NASA project to demonstrate suitability of solar cells to provide energy in developing countries.

In a similar NASA/Energy Department program, the world's first solar-electric-powered village was dedicated at Schuchuli, Ariz. The system powers 15 refrigerators, a washing machine, sewing machine, water pump and 40 fluorescent lights for the 96 residents of the Papago Tribe.

A new, efficient home-sized solar-powered air conditioning system has been developed and tested, under an Energy Department/NASA program. The 3-ton cooling capacity unit is sufficient to cool the average U.S. home.

A unique energy-storage system developed by NASA promises major cost reductions in storing electrical energy, as well as offering long-term reliability and minimal environmental impact. Called Redox, the system could help speed the growth of solar-electric and wind-energy systems where cost of energy storage has been an important consideration.

Two additional large wind turbines became operational this year, a 200-kilowatt system at Block Island, R.I., and a 2-megawatt system at Boone, N.C. The Boone machine is the world's largest operational wind system. Five machines of varying power production capability are now in operation in this Energy Department/NASA program.

Technology Utilization

The Technology Utilization Program, designed to promote and encourage the secondary application of aeronautics and space technology, has continued to broaden the scope of its industrial and public sector user base.

The experimental State Technical Assistance Centers in Florida and Kentucky have been assisting state and local government as well as small businesses and local industry in those states. The University of Kentucky center was instrumental recently in assisting a new firm, All-Weather Insulation, Inc., of Springfield, Ky., which makes a cellulose insulation product from shredded newspapers. The Kentucky center provided information about the proper chemicals to add to newspapers to meet federal insulation specifications and the proportions to mix the basic materials to yield uniform densities to meet the requirements of nonflammability and obtain an adequate R-factor. The firm is marketing the product now in Kentucky, Ohio and Indiana. With an initial investment of $170,000, the company is now generating revenues of $30,000 a month, employs nine workers, and anticipates revenues of over $400,000 by the end of this year.

In another example, the NASA Industrial Application Center at the University of Pittsburgh held a three-day conference on microprocessor technology for industrial firms in the Wilkes-Barre, Pa., region in cooperation with the mayor's Office of Economic Development. The local Chamber of Commerce, Wilkes College, King's College, the Economic Development Council of Northeast Pennsylvania as well as the United Penn Bank of Wilkes-Barre, participated. Technical survey papers on microprocessor applications were presented by NASA engineers from the Lewis Research Center. Other application centers are exploring opportunities to involve local communities in their technology transfer programs.

Space and Terrestrial Applications

The development, demonstration and transfer of space research and technology to meet specific national and world needs continues as the goal of the NASA Office of Space and Terrestrial Applications.

In the field of communications, the Communications Technology Satellite and Applications Technology Satellite-6, NASA's powerful experimental communications satellite, were retired. NASA continues communication research and development with a carefully mapped four-part program: advanced research and development, public service communications, advanced applications of satellite communications techniques and technical consultation and support.

Results from remote sensing experiments were most encouraging in 1979.

The Total Ozone Monitoring System, carried on Nimbus-7, launched in October 1978, is providing the first global mapping of total ozone with high spatial and temporal resolution. This represents the first time scientists have been able to study short period dynamic effects in the ozone distribution. A series of these measurements will help provide the necessary information to detect long-term globally averaged ozone changes in the atmosphere, natural or manmade. Decisions on the use of freon refrigerants or high flying aircraft may hinge on how well we can understand their impacts on the ozone layer.

NASA, through an agreement with the National Oceanic and Atmospheric Administration, provides research and development support for a series of weather satellites.

In June, NASA launched NOAA-A which is providing improved meteorological data.

NASA continues to participate with the National Oceanic and Atmospheric Administration, the National Science Foundation and others in the Global Weather Experiment as part of the Global Atmospheric Research Program involving more than 140 nations.

NASA is also concluding an agreement with the Japanese to use the U.S. GOES-A satellite and the Japanese Geostationary Meteorological Satellite to attempt stereo imagery of cloud heights over the Pacific Ocean. Cloud heights offer clues to the behavior of the storms they accompany.

Other environmental observation techniques underway or under study include using a camera to observe lightning phenomena from space, the Measurement of Air Pollution from Satellites experiment to measure carbon monoxide in the troposphere and the Atmospheric Cloud Physics Laboratory experiment designed to study development of ice crystals and water droplets in the absence of gravity.

NASA's evolving climate program emphasizes the application of space observations to improved understanding of climate influences and trends.

A special study of aerosol effects on climate, including both theoretical studies and measurements of aerosols in the atmosphere, was initiated. Theories predict a large volcanic eruption can inject enough material into the atmosphere to cause changes in the Earth's surface temperature.

The Stratospheric Aerosol and Gas Experiment satellite observed the violent eruptions of the volcano La Soufrier in the Carribean in April 1979. A number of such events have been documented in the past but the satellite offers the first remote-sensing capability to measure quantitatively such phenomena and globally map the spreading volcanic veil.

Tracking aerosol dispersions from such a well-characterized event as the La Soufrier eruptions gives researchers an insight as to how pollutants might also be transported globally. Thus, planners in the future may be able to locate industrial centers with high air-waste byproducts to minimize the effects on other geographic areas.

Other investigations of the upper and lower atmosphere and ocean surfaces have yielded important clues to understanding the Earth's climate.

The most significant gains in land observations were in the field of agriculture. It was demonstrated that remotely sensed data can be used for the direct separation of spring wheat and barley and for the separation of corn and soybeans.

A major portion of resource observations this past year has been devoted to insuring continuity of remotely-sensed data for researchers and operational users. Maintaining a flow of data from orbiting satellites is of immediate importance and Landsat-2 and Landsat-3 both continue to perform at near nominal levels despite some systems problems.

Requests for Landsat data over the past year reveal increasing worldwide interest in applying the technology to environmental and resources management problems. The Landsat ground station in India became operational in August, bringing the number of foreign stations to eight. Mexico has expressed interest in establishing a data-receiving capability and requests for coverage from other countries worldwide continue at an unprecedented level with a substantial number coming through the Agency for International Development.

Among U.S. users the largest demand is for agricultural studies, especially during the growing season where repetitive coverage in nine-day cycles and rapid data delivery are essential to success.

The Heat Capacity Mapping Mission, launched in 1978 into a Sun-synchronous polar orbit, has acquired much useful data. However, continuing power supply problems, due to two dead cells in the battery, have limited data acquisition to seven daylight passes and one night pass each day, rather than the planned seven daylight and seven night passes. The radiometer onboard continues to operate flawlessly and excellent data are being received.

Magsat, the first spacecraft specifically designed to conduct a global survey of Earth's vector magnetic field, was launched on Oct. 30 from the Western Space and Missile Center, Lompoc, Calif. This satellite was placed into a significantly lower orbit than previous magnetic field measuring satellites to provide more detailed and precise information about the nature of magnetic anomalies within the Earth's crust.

These anomalies are directly related to crustal structure. Magnetic anomaly mapping will help improve large scale models of crustal geology, enhancing our ability to conduct regional mineral assessment studies in remote unexplored areas.

The goal of the Geodynamics Program is the improvement of understanding of dynamic processes within the solid Earth, through observation of crustal movements and deformations. Mobile laser units are now operating in Australia, American Samoa and Kwajalein Island. These and other fixed lasers at worldwide locations form an international network for global observations of tectonic plate stability and motion. Confirmation of the rates and direction of plate motion, which will take many years, will increase our understanding of how and why earthquakes occur.

International Affairs

The year began with the signing of the U.S.-China Agreement on Cooperation in Science and Technology, signed by President Carter and Chinese Premier Deng Xiaoping on Jan. 31, 1979. This agreement formalized the NASA/Chinese Understanding reached in December 1978 for China to purchase from U.S. industry, under suitable conditions, a U.S. satellite broadcasting and communications system, including the associated ground receiving and distribution equipment and a ground station capable of receiving Earth resources data from the NASA Landsat remote-sensing satellites.

NASA is currently working on a Landsat ground station memorandum of understanding with the Chinese Academy of Sciences. The Chinese Communication Satellite Corporation is drafting final technical requirements for the satellite system, in preparation for the beginning of intensive talks with potential U.S. suppliers.

Fourteen U.S. experiments were launched in September aboard an unmanned Soviet biological satellite -- Cosmos 1129 -- along with experiments from the Soviet Union and several other countries. All the experiments were designed to test the effects of weightlessness on physiological processes.

U.S. participation in the 19-day flight included experiments with biological specimens (rats, quail eggs), space radiation, dosimetry and post-flight specimen preparation in Moscow. U.S. scientists are now analyzing the flight material and expect to present their results at a joint meeting in 1980.

The first joint U.S./U.S.S.R. ground-based study to investigate physiological changes in humans resulting from simulated weightlessness was conducted during 1979. In May, during the first phase of the study, two NASA scientists participated as observers in an experiment at the Institute of Biomedical Problems in Moscow. In the second phase of the study, two Soviet scientists, both medical doctors, observed NASA's experiments at NASA's Ames Research Center, Mountain View, Calif.

The joint study is expected to help standardize physiological measurements and techniques for studying cosmonauts and astronauts. Scientists also expect the study to improve bedrest test procedures and help reduce duplication in testing.

The results of these ground-based studies were discussed at the U.S./U.S.S.R. Joint Working Group on Space Biology and Medicine at NASA's Johnson Space Center, Houston, Oct. 22-31. The participants also discussed biomedical results of space flights in the preceding year; future joint life sciences experiments; controlled ecological life support systems; decompression sickness and other subjects of mutual interest.

NASA and the Soviet Academy of Sciences exchanged the results from their respective 1978 Venus missions during an April meeting of the Joint U.S./U.S.S.R. Planetary Working Group in Moscow. They also discussed areas of possible future cooperation and scientific objectives for the exploration of the solar system.

NASA, the Canadian Department of Communications and the French Centre National d'Etudes Spatiales have agreed to evaluate a Satellite-Aided Search and Rescue System, designated SARSAT. Plans call for a 15-month orbital demonstration and evaluation beginning in 1982.

The system is expected to dramatically reduce rescue response time to accident sites by improving distress monitoring coverage, reducing detection time and providing more accurate initial location and distress incidents.

The SARSAT parties and the Soviet Ministry of Merchant Marine recently signed an understanding regarding cooperation between SARSAT and a similar Soviet system. Under the terms of the understanding, which must be confirmed, the Soviet system (COSPAS) would be interoperable with the U.S., French and Canadian one. The joint system will have a better alert and response time than either system would have acting alone.

NASA's activities with the European Space Agency included signing an agreement for a joint International Solar Polar Mission. The two-spacecraft mission will observe the Sun above its polar regions for the first time.

Under the agreement, NASA and the 11-member European group will each provide a spacecraft. In addition, scientists from the Federal Republic of Germany, the United Kingdom, France and Switzerland will provide mission experiments for the U.S. spacecraft.

Full-scale preparations have begun for NASA operation of Spacelab, the multipurpose laboratory that the European Space Agency is developing for NASA's use aboard the Space Shuttle. Integration and testing of the first Spacelab flight unit have begun in Europe. Preparations are underway for flight of the first Spacelab mission, currently planned for 1982.

A joint group from NASA and Japan's Space Activities Commission studied potential joint projects and recommended beginning projects or studies in 17 different areas of space science and applications. These range from joint efforts in Earth crustal dynamics research that could begin in the near future, to possible participation by Japan in NASA's planned Saturn Orbiter Dual Probe mission for launch in 1985 to study Saturn and its moon Titan.

Twenty rocket-borne ozone-study experiments were conducted from NASA's Wallops Flight Center, Wallops Island, Va., during a 14-day period in October to establish instrument precision and comparability for scientists and engineers from five countries -- Australia, Canada, India, Japan and the United States. They participated in the experiments to compare techniques of gathering information about ozone in the Earth's stratosphere.

An historic U.S.-Canadian joint experiments program to advance communications via satellite ended in June when the world's most powerful communications satellite relayed video and voice signals for the last time. The Communications Technology Satellite has demonstrated that such powerful satellite systems can bring low-cost television to remote areas anywhere on the globe.

NASA signed memorandums of understanding with Japan, Australia and Thailand for setting up three foreign Landsat ground stations. The stations will receive, process, record and disseminate Landsat data.

Landsat ground stations in India and Australia began receiving test data this year bringing total foreign operated Landsat ground stations to eight in seven countries: Australia, Brazil, Canada (two stations), Italy and Sweden (both under European Space Agency auspices), India and Japan. Another ground station is presently under development in Argentina and others are being planned.

NASA launched, on a reimbursable basis, a United Kingdom satellite, called Ariel 6 (also UK-6) aboard a Scout launch vehicle from Wallops Flight Center on June 2. The satellite is conducting scientific measurements in high-energy astrophysics.

In April, NASA signed an agreement with Indonesia to launch two Indonesian domestic communications satellites aboard the Space Shuttle.

In addition to Indonesia, earnest money deposits from agencies in Canada, Germany, India, Intelsat and the Arab Satellite Communications Organization have been received for Space Shuttle launches in the early 1980s. There also have been deposits from a score of foreign individuals and organizations in nine countries for about 60 flights of small self-contained research and development packages on the Space Shuttle.

Aeronautics

Research and technology developments during the past year reached several major milestones toward achieving quieter, safer, more energy-efficient aircraft.

The Quiet Short-haul Research Aircraft and NASA/Army Rotor Systems Research Aircraft began producing valuable flight data.

The NASA/Army Tilt Rotor Research Aircraft successfully completed full transition to the airplane flight mode from the helicopter flight mode.

The Highly Maneuverable Aircraft Technology remotely piloted research vehicle successfully made its first proof-of-concept flight.

The Oblique Wing research aircraft advanced to final preparations for its first test flight, expected near the end of the year.

The Terminal Configured Vehicle aircraft demonstrated efficient descent and airport approach paths, precision flight path control using the Microwave Landing System and Area Navigation, and onboard displays to improve safety and improve airspace, runway and crew utilization.

The Aircraft Energy Efficiency Program has identified advanced technologies that could reduce fuel consumption by 50 percent in future generation, new aircraft. In the energy efficient engine phase of the program, design information and experimental data indicate this engine technology could reduce fuel burned by 14 to 22 percent depending on flight length, reduce operating costs by 5 to 10 percent and reduce engine performance deterioration by 50 percent compared to current high-bypass turbofan engines.

Primary goals of the Quiet, Clean, General Aviation Turbofan engine program were met, including significant reduction of engine noise and pollutant emissions. The engine proved to be 10 to 14 decibels lower than the quietest current business jet engine, corresponding to a 50 to 60 percent reduction in perceived noise. The program also demonstrated a 54 percent reduction in carbon monoxide, 76 percent reduction in unburned hydrocarbons and significant reductions in nitrous oxides.

Flight demonstration of an experimental Automatic Pilot Advisory System, using a computer-generated voice technique, to provide general aviation pilots flying in uncontrolled airport traffic with airport and air traffic advisory messages is under way. The system automatically tracks aircraft within three miles of an uncontrolled general aviation airport and broadcasts information on traffic location and heading, wind, barometric pressure, temperature and active runway information.

Space Research and Technology

Research and technology developments for advanced space systems yielded progress across a broad spectrum of programs. Solar electric propulsion technology development advanced to the flight readiness demonstration phase. A large, unfurlable 12.5-kW array is being readied for a Space Shuttle flight test and an 8-centimeter Solar Electric Propulsion engine is being prepared for an Air Force flight test program.

A new concept in high-density information storage systems was demonstrated, called a multi-layer magnetic lattice file. In the mid-1980s the concept could provide 50 times greater storage capacities at equivalent size, weight and power when compared to present solid-state semiconductor memories.

An ultra high-speed, image-processing computer, called the Massively Parallel Processor, reached the developmental phase this year, for eventual use in analyzing the large amounts of data expected from future Earth observational spacecraft. The new technology will permit processing of images from 10 to 100 times faster than is now possible, at greatly reduced cost. The processor is expected to perform over 6 billion additions or almost 2 billion multiplications per second.

The processor technology will play an important role in NASA's End-to-End Data System Program, aimed at providing space-acquired information to users throughout the world in near real time.

Development was completed on two new thermal protection materials for use on selected portions of the second and subsequent Space Shuttle orbiters. One material offers a substantial cost savings, while the other is twice as strong with a higher temperature capability compared with the materials it replaces.

An important step in the development of laser propulsion technology was achieved with the demonstration this year of a laser-sustained plasma of pure hydrogen. A performance level now appears attainable which would make laser propulsion attractive for future low acceleration orbital transfer missions.

Tracking and Data Systems

Communications, tracking and data acquisition and processing services were provided for more than 50 spacecraft on inter-planetary and Earth-orbital science and applications missions.

Millions of bits of data were transmitted across the solar system from distances as great as a billion and a half kilometers, a process sometimes requiring nearly three hours for a round-trip communication at the speed of light. Several new Earth-based concepts were successfully employed this year to improve data acquisition over these interplanetary distances.

To obtain the maximum science benefits from a deep space science mission, spacecraft like Voyager 2 and Pioneer use the natural gravitational pull of appropriate solar system planets to "reboost" and "redirect" the spacecraft on the corrent trajectory to explore a second, more distant planet.

The Deep Space Network, this year, tested a new technique with Voyagers 1 and 2 to give flight controllers on Earth the precise navigational information necessary to successfully maneuver the spacecraft toward the new target planet using gravity-assist.

1979 NASA LAUNCH RECORD

Date	Payload	Launch Vehicle	Launch Site	Mission Remarks
January 30	SCATHA	Delta	Cape Canaveral	Satellite to study electrical charge buildup on spacecraft for Air Force.
February 18	SAGE	Scout	Wallops	Gathering data on ozone and aerosols in stratosphere.
May 4	FLTSATCOM-2	Atlas Centaur	Cape Canaveral	Satellite is part of world-wide armed forces communications system.
June 2	UK-6 (Ariel)	Scout	Wallops	Scientific studies in high-energy astrophysics.
June 27	NOAA-A	Atlas E/F	WSMC	Environmental monitoring satellite.
August 9	Westar-3	Delta	Cape Canaveral	Communications satellite.
September 20	HEAO-3	Atlas Centaur	Cape Canaveral	Study of cosmic ray particles and gamma ray photons.
October 30	Magsat	Scout	WSMC	Measure near-Earth magnetic field and crustal anomalies.
December 6	SATCOM	Delta	Cape Canaveral	Communications satellite (lost after transfer from NASA to RCA).

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