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Goddard Space Flight Center

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Nimbus Spacecraft Observes the Planet Earth—for Twenty Five Years

by Carolynne White

On August 28, 1964, a Thor-Agena expendable launch vehicle catapulted the first Nimbus Earth-observing spacecraft into orbit around planet Earth, beginning 25 years of Earth observations and record-setting accomplishments in technological developments, scientific research, and practical applications.

The butterfly-shaped Nimbus-1 orbited the Earth for 24 days, providing the first high-quality visible spectrum and infrared weather photographs of the Earth from space, but, more importantly, it demonstrated the Nimbus design concept and pointed to future successes of the next generation.

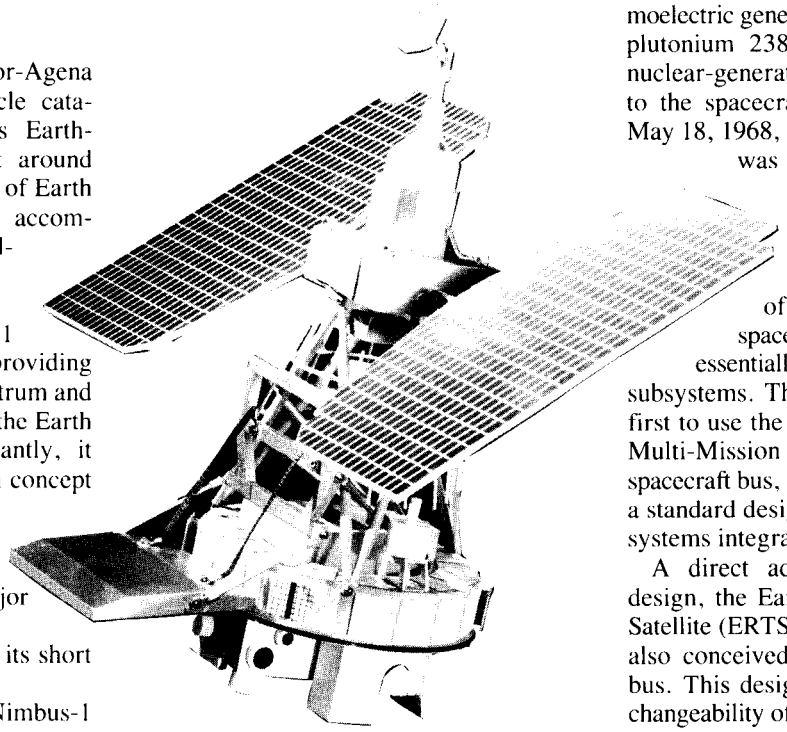
Though it operated for only one month before it suffered a major failure within its power system, Nimbus-1 made optimum use of its short lifetime.

During its first day in orbit Nimbus-1 photographed Hurricane Cleo, and later took exceptionally clear photos of Hurricane Dora and Typhoon Ruby.

The 830-pound (377 kilograms) satellite launched into polar orbit that day in August 1964 carried only three instruments, operating in only three channels of the electromagnetic spectrum: a capability for Automatic Picture Taking (APT) using a slow readout vidicon camera to provide actual images of local cloud cover; the Advanced Vidicon Camera System (AVCS) to provide high-resolution cloud cover images; and a High Resolution Infrared Radiometer (HRIR) to gather nighttime cloud cover data.

Over the next twenty-five years, the Nimbus series of seven satellites was to become the workhorse and experimental backbone of the NASA Earth observation from space research program. Following Nimbus-1, the satellites grew in sophistication, complexity, weight, capability and performance.

Today Nimbus-7, launched on October 24, 1978, observes a given point on the Earth twice a day, covering 79 spectral channels and providing images and data to scientists and meteorologists from two of its eight complex instruments studying all aspects of the Earth's atmosphere and oceans. The Nation's principal low altitude observatory for atmospheric research and global weather surveillance, Nimbus-7 provided information on fishery resources, weather modeling, atmospheric pollution monitoring, Earth's radiation budget, ozone monitoring, ocean dynamics, and the effects of cloudiness on the Nimbus-7 instruments outputs.



Technology Firsts

The Nimbus-1 spacecraft was, among other things, the first spacecraft stabilized with three-axis pointing, keeping the spacecraft oriented towards the Earth's center with an accuracy of better than one degree.

Nimbus had two solar paddles to track the sun during daylight operation and convert the energy into electrical power for the spacecraft's subsystems. The fourth of the Nimbus spacecraft, Nimbus-3, launched on April 14, 1969, was the first to demonstrate the use of radioisotope thermoelectric generators (RTG's), which used plutonium 238 to provide 30 watts of nuclear-generated electric power directly to the spacecraft. (Nimbus-B, launched May 18, 1968, carried the first RTG's, but was destroyed by range safety two minutes after launch due to a launch vehicle malfunction.)

Unlike previous series of spacecraft, the Nimbus-1 spacecraft and its successors had essentially interchangeable parts and subsystems. The Nimbus system was the first to use the now-familiar concept of a Multi-Mission Satellite (MMS) design, or spacecraft bus, where the basic satellite has a standard design, with the parts and subsystems integrated assembly-line fashion.

A direct adaptation of the Nimbus design, the Earth Resources Technology Satellite (ERTS, now called Landsat), was also conceived as a standard spacecraft bus. This design enabled ease and interchangeability of major system elements not only between concurrently produced Nimbus satellites, but also between Nimbus and Landsat in the latter years of the program.

In communications, the Nimbus satellite system was the first to demonstrate two-way data transmission (telemetry and command) between a low Earth orbiting satellite through a geosynchronous satellite to provide continuous communications to a ground station. The geosynchronous Applications Technology Satellite (ATS)-6

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Talk from the Top

John W. Townsend Jr

Several employees have expressed concern about speeding vehicles on Explorer Road:

Q: Excessive speeds on exit roads such as the exit road to the Baltimore Parkway are endangering pedestrians on crosswalks. Why aren't more speed checks made?

Q: This morning a deer was hit while crossing the road from the BW Parkway, in front of the pond. Next time it could be a pedestrian. . . something needs to be done to hold down the speed on the road to the Parkway.

A: Our ongoing efforts at reducing the speed of vehicles on Center, with special interest directed to Explorer Road (to and from the BW Parkway), have increased during recent weeks. Our old radar gun has been repaired and calibrated, and radar checks have been reinstituted. We have ordered a state-of-the-art radar gun with a digital speed display board so that we can "advertise" to drivers (as well as fellow drivers in close proximity) the speed they are traveling. . . We are also considering placement of "rumble strips" in the road when the Parkway Gate is closed next year in conjunction with Parkway reconstruction efforts. Other actions we have taken include a fresh coat of paint on the pedestrian crosswalks, the use of traffic cones to slow and control traffic at the gates, a Blind Pedestrian crossing sign on the way in from the Parkway, and a four-way stop sign on Explorer Road between Buildings 11 and 21 to help with the increased traffic in the area and to slow down drivers who are used to expressway speeds. . . .

Center Director John W. Townsend, Jr. wants to hear from you! Send your questions to: TALK FROM THE TOP, Code 130.

FOR UP-TO-DATE INFO:

DIAL 286-NEWS

Three New Code 250 Programs to Streamline Dealings With Computers

Three new projects out of the Information Management Division (Code 250) will help Goddard microcomputer users to buy computers faster, use them more efficiently, and solve computer use problems more easily.

The first project is a mass buy of MS-DOS, IBM-compatible microcomputers for the center, which was recently awarded to WIN Laboratories of Vienna, VA; this will make it easier and simpler for Goddard offices to procure these workstations. Second, the centerwide Information Resources Oversight Committee (IROC) recently issued a policy for standardization of word processing which selects a recommended family of proven word processing packages based in part on a survey of existing packages in use. And finally, the Technical Support Group is now operating under a Microcomputer Support Policy designed to focus the efforts of the group on key areas to meet demands for support on center.

Speedy Procurement

Mark Walther, Head of the Automation and Planning Branch and a key staff member to the centerwide IROC, believes that the mass buy not only will streamline the process of buying workstations but also provide for better service for the workstations.

"There is a big difference in procurement lead-time with a mass buy, once it is awarded," said Walther. "But the other benefit of buying 500 or 600 workstations at one time is that we have a known product, a practically universal workstation. This allows the Information Technology Center (ITC) and the microcomputer maintenance staff to provide better service."

Walther predicts that, ultimately, each secretary and clerical at Goddard will have more or less the same equipment, with the same on-screen interface and word processing packages If a secretary or clerical changed jobs at Goddard, they would be greeted by a familiar microcomputer environment in their new office.

Standard Software

Along the same lines, the new policy encouraging the use of standard word processing software packages will ensure that microcomputer users can get technical support for their software and make it easier to purchase the recommended software.

"From an information technology standpoint, Goddard is a very independent and innovative center in the way individuals do their computing," Walther said. "There is an understandable resistance to standardization and it's difficult to get a centerwide community to agree on a single word processing software package."

A centerwide survey revealed that more than one-third of the word processing packages in use on center for both Apple and MS-DOS microcomputers are either Microsoft Word or WordPerfect. These packages then were selected to be recommended by the IROC based on four criteria: they have both DOS and MAC versions; they offer a network version; they provide an option to be used with more mainframes; and they are both highly rated, proven, dependable, user-friendly, and industry-respected word processing products.

Focused Support

For more than four years the Technical Support Group has been finding lost data, explaining cryptic error messages, and rescuing hapless microcomputer users around center.

Center microcomputer users can rest assured that the new Microcomputer Support Policy (MSP) will not adversely affect the service they are used to finding when they dial x69508 for help.

The policy is designed to help the group, with limited personnel and financial resources, to cope with the problem of a vast and increasing range of commercially available computer products while maintaining their expertise and maximizing support.

"There are so many software products on the market and in use at Goddard, that each member of the Technical Support Group can't be the expert in all of them," said Walther. "The policy tries to give the group a focus for the areas in which they can best provide support.

"All three of these measures are part of a natural evolution in Goddard's microcomputer environment," Walther said of the new policies and the mass buy. "We're basically instituting policies and programs that reflect the Goddard consumer's needs and the current and future office automation marketplace."

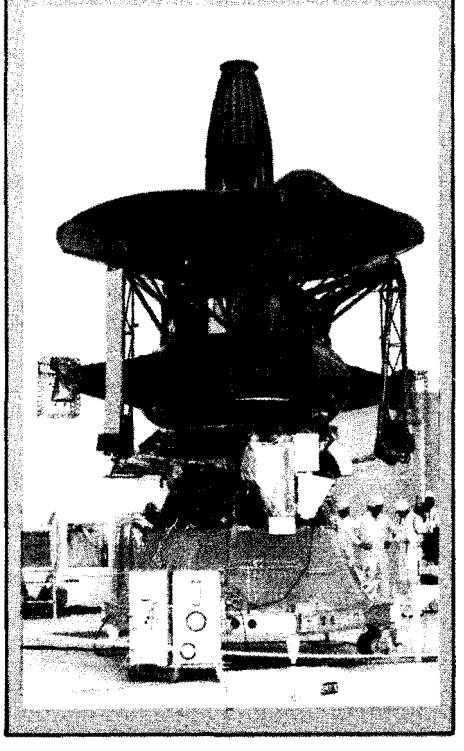
Launch Update: Galileo Ready

The Galileo spacecraft, scheduled for launch aboard the shuttle Atlantis no earlier than October 12, 1989, was mated with its Intertial Upper Stage at Kennedy Space Center during the week of September 1.

High fidelity mock radioisotope thermoelectric generators (RTG's) were installed in two positions aboard the Galileo spacecraft in an exercise designed to verify procedures, provide training, and insure that access for the installation is sufficient.

This photograph of the Galileo spacecraft, in the clean room at Kennedy Space Center's SAEF-2 planetary spacecraft checkout facility, was taken before the spacecraft was moved to the Vehicle Processing facility.

When it is launched in October, Galileo will make a six-year journey to the planet Jupiter. In December 1995, as the two-and-one-half-ton spacecraft orbits Jupiter with its ten scientific instruments, a probe will be released to parachute into the Jovian atmosphere. Goddard scientists and technicians play a significant role in this planetary space venture—(See story next month for details.)



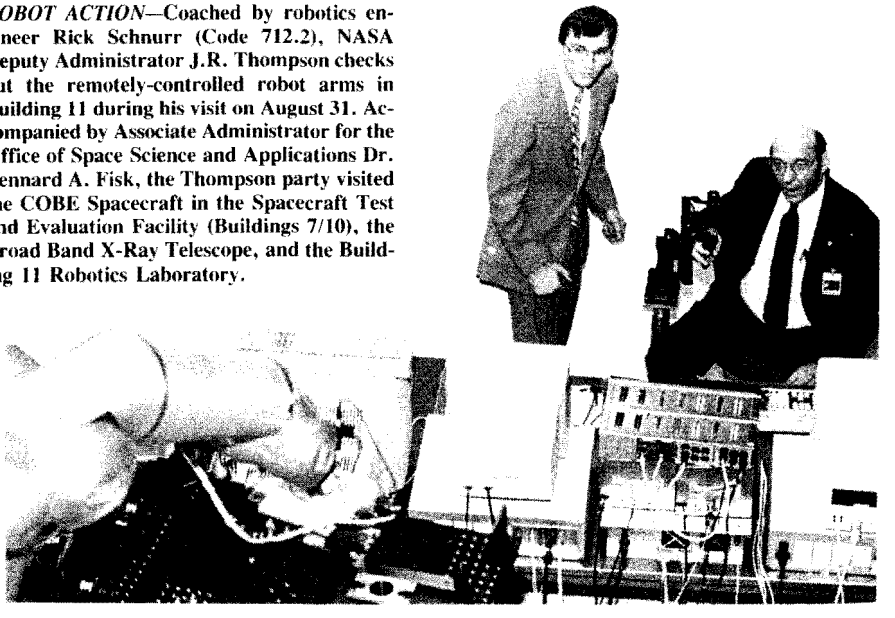
NASA Pipeline

MARSHALL SPACE FLIGHT CENTER, Huntsville, AL—Marshall Space Flight Center, Huntsville, Alabama, recently awarded a $1.797 billion contract modification to the Martin Marietta Corp., New Orleans, La., to produce 60 additional Space Shuttle external tanks for delivery during the 1990s. The award is the second portion of a procurement to obtain the tanks. The first portion, awarded to Martin Marietta in June 1988, was for the long-lead hardware (parts and materials) needed for manufacture of the tanks. The tanks will be produced by Martin Marietta's Manned Space Systems Co. at NASA's Michoud Assembly Facility near New Orleans. The first tank to be built under the new contract is expected to be completed in late 1991 and the 60th in mid-1997.

LANGLEY RESEARCH CENTER, Hampton, VA—NASA has awarded initial research and development contracts with a potential value of $89 million to 15 aerospace companies and universities as part of the newly established Advanced Composites Technology (ACT) program. Recognizing the importance of developing new, high-strength plastics to maintaining U.S. leadership in the manufacture and sale of commercial airliners, NASA is seeking technology breakthroughs in these materials. Such breakthroughs would allow structures made of epoxy-type resins and high-strength carbon fiber to replace metal in the wings and bodies of future transport aircraft.

NASA HEADQUARTERS, Washington, DC—NASA recently announced the selection of 17 universities and consortia as Designated Space Grant Colleges/Consortia in the first element of NASA's new National Space Grant College and Fellowship Program, mandated by Congress in 1987. These designated institutions, which are already significantly involved in space-related activities, will receive grants and fellowships. The designated colleges/consortia were selected based on a competitive evaluation of the institutions' existing aerospace activities as well as the quality of their plans to strengthen the national educational base for science, math and technology. The original program announcement forecast the number of expected space grant college designations as no more than 12, due to anticipated budget limitations. However, NASA Administrator Richard H. Truly decided to extend designations to 17 colleges/consortia in response to the high quality of the proposals received and as an indicator of NASA's desire to get this important program off to a strong start.

ROBOT ACTION—Coached by robotics engineer Rick Schnurr (Code 712.2), NASA Deputy Administrator J.R. Thompson checks out the remotely-controlled robot arms in Building 11 during his visit on August 31. Accompanied by Associate Administrator for the Office of Space Science and Applications Dr. Lennard A. Fisk, the Thompson party visited the COBE Spacecraft in the Spacecraft Test and Evaluation Facility (Buildings 7/10), the Broad Band X-Ray Telescope, and the Building 11 Robotics Laboratory.



Nimbus Spacecraft

Continued from page 1

was used as a relay to the ground from Nimbus-6, launched on June 12, 1975, even before the Tracking and Data Relay Satellite System, now used for two-way communication, was developed.

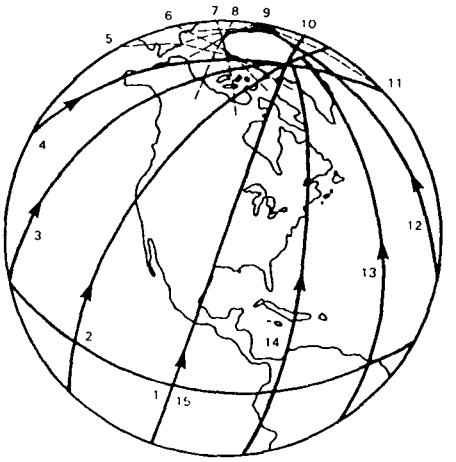
Applications

Originally conceived by the United States Weather Bureau (now the National Oceanic and Atmospheric Administration, NOAA) and NASA as a series of operational weather satellites, the Nimbus series became primarily scientific when cost growth and schedule delays, due to early problems in developing the attitude control system and proving operational characteristics in a simulated space environment, caused the Federal agencies to reconsider the operational commitment.

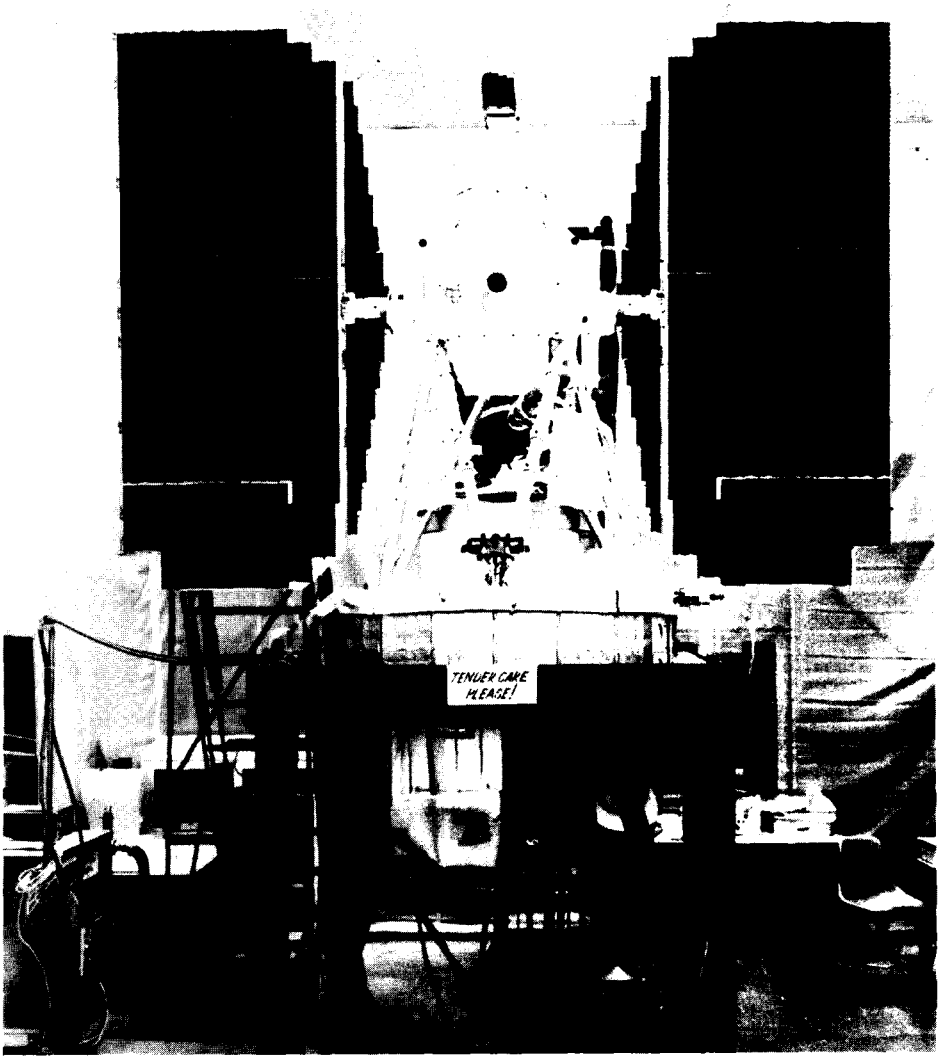
A major achievement of the Nimbus program was the development of instruments to measure the temperature profile of the Earth's lower atmosphere and stratosphere, which provided the world's meteorologists with worldwide data for weather forecasting numerical models. The weather forecasting capabilities most Americans take for granted today came about largely as a result of instruments like the Satellite Infrared Spectrometer (SIRS), which measured infrared spectral radiances in the carbon dioxide absorption band of Earth's atmosphere, and the Pressure Modulated Radiometer (PMR) which produced vertical temperature profiles of the Earth's atmosphere to 52 miles (85 kilometers).

Beginning with these initial achievements in weather forecasting, however, and continuing with the use of Nimbus for polar ice mapping, and the tracking of adventurers, animals, and balloons, the Nimbus series has proven itself with a succession of applications successes.

For example, Nimbus-4 was launched April 8, 1970 carrying nine experiments for reliable, long-range weather forecasting. In addition to its achievements in differentiating between ice and water clouds and determining wind fields by tracking balloon platforms, the satellite was used to track a migratory Elk in a wildlife management experiment in Yellowstone Park.



EARTH COVERAGE—**The daily repeating orbital pattern of Nimbus 6 and 7 covers any given point on the Earth's globe twice each day, once in daylight and once by night.**



TABLED BUTTERFLY—**The Nimbus-7 spacecraft sits on a workstand at General Electric's plant in Valley Forge, PA. As if mindful of the future contributions of Nimbus-7, a sign reads "Tender Care Please!"**

The 28-day experiment involved a 24-pound (11-kilogram) transmitter equipped with solar cells and a receiver for the Nimbus spacecraft's Interrogation, Recording, and Location System (IRLS), attached to the elk's neck. Success with this experiment led to a contract in 1977 with the U.S. Fish and Wildlife Service (USFWS) to track select pregnant female polar bears in Alaska, using the random access measurement system (RAMS) aboard the Nimbus-6 satellite.

USFWS officials were concerned that increased human presence in conjunction with the Alaska pipeline might adversely affect the animals. A small 11-pound (five kilogram) transmitter attached to the polar bears' necks returned a location signal to the Nimbus-6 satellite, which relayed the signal to monitoring facilities at Goddard. The USFWS Alaska Office then received computer printouts of the satellite data showing the location of the bears.

In similar experiments, Nimbus spacecraft have been used to track icebergs in the Atlantic Ocean, porpoises in the Pacific Ocean near Hawaii, basking sharks in Kilbrannan Sound off the coast of Scotland, and Sea Turtles in the South Atlantic Ocean near Texas and Louisiana.

The RAMS receiver onboard the Nimbus-6 satellite was also used in several navigation and position location experiments, including a project to track balloon adventurers Ben Abruzzo, Maxi Anderson, and Larry Newman on their record-

setting transatlantic balloon crossing in 1978. In a cooperative effort between NASA and the Federal Aviation Administration (FAA), their balloon, the Double Eagle II, carried a transmitter to convey a signal to the spacecraft. This provided the position data that allowed the balloon's ground support personnel to follow the Double Eagle II in the first successful balloon crossing of the North Atlantic, which terminated in a widely publicized landing in a field outside Paris in October 1978.

Later, British balloonists Cameron and Davey also carried a Nimbus transmitter onboard their balloon in July of 1978, in their attempt to cross the Atlantic, which took them from St. Johns, Newfoundland, to Britanny, France.

Japanese adventurer Naomi Uemura carried a transmitter during his two-part dogsled trek from Ellesmere Island to the North Pole (500 miles) and down the spine of Greenland (1678 miles) in the spring and summer of 1978, at the request of the Smithsonian Institution, who wanted to compare the Nimbus spacecraft data with the dead reckoning and celestial navigation techniques used by the adventurer. The expedition was sponsored by the National Geographic Society, Japan's Mainichi newspaper and TV network, the Japanese magazine *Bunegi Shunju*, and by numerous corporations and individual donors.

The tracking capabilities of the Nimbus spacecraft were also used in a Drug Enforcement Agency (DEA) experiment tracking an automobile traveling from Baltimore, MD to Fredericksburg, VA, via I-95; a Smithsonian Institution scientific expedition of U.S. and Egyptian scientists into the western Egyptian desert; and British mariner Peter Bird's solo attempt to row across the Pacific Ocean in a 35-foot rowboat in 1980.

Scientific Achievements

Named after the Latin word for raincloud, Nimbus originally was conceived as a meteorological satellite concerned primarily with providing atmospheric data for improved weather forecasting. With the addition of more sophisticated sensing devices on each succeeding spacecraft, the research observatory aspect of the Nimbus series grew in capability and to encompass a wide range of Earth sciences.

Data produced by the 48 instruments and sensors flown on seven Nimbus spacecraft over the last 25 years are still being studied—and applied—in the fields of oceanography, hydrology, geology, geomorphology, geography, cartography, agriculture, and meteorology.

MAMA BEAR—**A U.S. Fish and Wildlife Service (USFWS) official poses with a tranquilized pregnant female polar bear, after fitting her with a collar containing a transmitter for the Nimbus-6 random access measurement system (RAMS). A 28-day USFWS experiment conducted in 1978 tracked the movements of polar bears to determine the effect of extended human presence during the construction of the Alaskan pipeline.**

Perhaps one of the most famous of the Nimbus instruments, the Coastal Zone Color Scanner (CZSC) produces the familiar vivid-color pictures depicting phytoplankton concentrations in coastal areas of the Earth ranging from the Mississippi River Mouth to the Pacific Ocean. Images produced by the CZCS can be enhanced with computer-generated false color to highlight areas with unusually high concentrations of chlorophyll found in certain types of plankton. In addition to its scientific value, this information is also used to identify preferred ocean areas for the commercial harvest of albacore tuna.

Other Nimbus contributions to oceanography include precise measurements of sea-surface temperatures and sea-surface wind-speed returned by the Scanning Multichannel Microwave Radiometer (SMMR). Until the flight of the first SMMR aboard Nimbus-7, meteorologists, climatologists, and oceanographers could not infer this information from a remote global position during cloudy periods. With the SMMR, they not only received accurate measurements, but could also determine the concentration and age of sea ice with a much greater accuracy than that using earlier satellite techniques. The SMMR supported maritime efforts of the U.S. Navy's Fleet Weather Facility (FWF), the Fleet Numerical Weather Control (FNWC), and the Naval Polar Oceanography Center (NPOC).

Another Nimbus instrument, the Total Ozone Mapping Spectrometer (TOMS), has provided scientists with valuable data on total amounts of ozone in the Earth's atmosphere, thought by some to be depleting from modern industrial processes, including the manufacture and use of chloroflourocarbons. Scientists at Goddard are studying recent measurements of both the North and South poles which seem to indicate an ozone "hole" in the atmosphere due to this depletion.

Throughout the 25 years of its lifetime, the Nimbus satellite program has continued to provide valuable scientific data in Earth science and observations. Modifications of early designs for the butterfly-shaped Nimbus spacecraft paved the way for the Landsat Series (formerly known as Earth Resources Technology Satellites). Uses of the Nimbus spacecraft in tracking and weather forecasting have opened up whole new fields in space applications.

Happy twenty-fifth birthday, Nimbus!

A celebration at the Goddard Recreation Center on August 29 honored the Nimbus satellite project's 25-year contribution to the space program. In honor of the project's achievements, Center Director Dr. John W. Townsend, Jr., designated Goddard Road #10 as Nimbus Road. A series of storyboards on display highlighted the achievements of the Nimbus project in technology development, science observations, and applications.

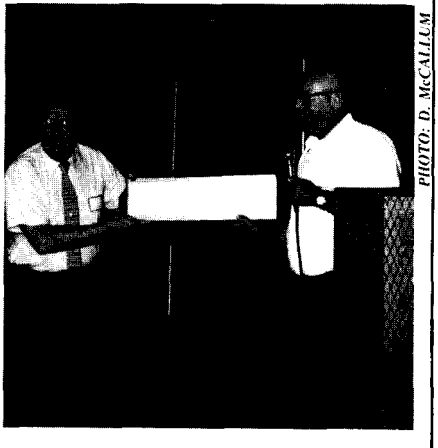


PHOTO: D. McCALLUM

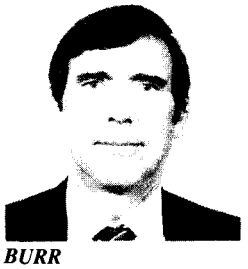
ROAD NAMING—**Center Director Dr. John W. Townsend, Jr. and former Nimbus Project Manager William Stroud (currently Special Assistant to the Deputy Director of Flight Projects for Planning and Business Management) present the road sign designating Goddard road #10 as Nimbus Road at the Nimbus 25th Anniversary Celebration August 29th at the Goddard Recreation Center.**

INSIDE

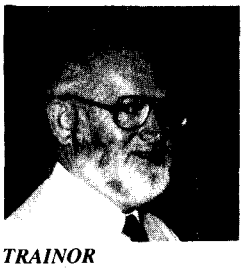
NASA Management Changes: Our Fearless Leaders

Goddard Appoints New Director of Flight Projects, Deputy, and Associate Director of Center

Effective August 13, 1989, **PETER T. BURR**, formerly Deputy Director of Flight Projects, was appointed Director of Flight Projects (Code 400). Previously Deputy Director of Flight Projects as of April 1988, he replaces Gerald W. Longanecker, who retired on July 14, 1989.


BURR

Burr has been with Goddard since 1960, when he began work as a research engineer with the Satellite Applications Systems Division. A two-time NASA Award winner, Burr also has served as head of the Information Systems Engineering Section in the former Tracking and Data Systems Directorate. He received a Special Achievement Award in 1980, and the NASA Outstanding Leadership Award in 1983. Other positions at Goddard have included Assistant Project Manager, then Project Manager, for the Test and Training Satellite; Spacecraft Manager for the Synchronous Meteorological Satellite; Study Manager, then Project Manager for the Solar Maximum Mission; and Project Manager for the Upper Atmosphere Research Satellite.


TRAINOR

Former Director of the Space and Earth Sciences Directorate (Code 600) **DR. JAMES H. TRAINOR** has been named Associate Director of Goddard.

Dr. Trainor came to Goddard in 1964 after receiving his Ph.D. in Physics at the University of New Hampshire. He served as Head of the Energetic Particles Instrumentation Section from 1967 to 1970; Head of the Instrumentation Branch from 1970 to 1975; and Associate Chief of the Laboratory for High Energy Astrophysics from 1975 to 1982; and Deputy Director of Sciences from 1982 to 1984.

In August of 1984 Trainor was named Deputy Director (Research) in the Space and Earth Sciences Directorate, after which he became Deputy Director of Space and Earth Sciences in June 1985. Since October 1987, Trainor has served Goddard as Director of Space and Earth Sciences.

Trainor has received frequent recognition for his scientific and managerial contributions, including the Goddard Exceptional Performance Award in 1970, the NASA Medal for Exceptional Scientific Achievement in 1974, the NASA Medal for Exceptional Service in 1977, and the Senior Executive Service (SES) Presidential Rank of Meritorious Executive in 1987.

HARRIS

DR. DALE W. HARRIS, Project Manager for the Tracking and Data Relay Satellite System (TDRSS) since 1980, has been named Deputy Director of Flight Projects.

Harris joined Goddard as an aerospace engineer in the Advanced Power Sources Section in 1963, following private industry positions working with nuclear airplane development for General Electric Co., Cincinnati, OH, and working on nuclear power supplies for Martin Marietta Co., Middle River, MD.

From 1963 to 1972 Harris worked on the application of nuclear power supplies to spacecraft, developed solar arrays, and studied radiation damage to solar arrays.

Harris became Head, Power Systems Design Section in 1972. From 1972 to 1979 he was Head of the Space Power Technology Branch. He managed the development of the first MPS, flown on the Solar Maximum Mission spacecraft.

NASA Headquarters Announces Management Changes

O'BRIEN

Effective July 30, 1989, **JOHN E. O'BRIEN** returned to NASA Headquarters as Assistant Deputy Administrator. In this position, O'Brien will support the agency's efforts in formulating plans to implement future goals in space, as outlined by President Bush in his July 20 speech. Also, he will perform special analyses for the Administrator and be involved in management problem solving.

O'Brien returns to NASA from the Washington law firm of Steptoe & Johnson where he specialized in defense and aerospace legal issues. He previously served as NASA General Counsel from August 1985 to July 1988 after serving as Deputy General Counsel since November 1981.

O'Brien received the NASA Exceptional Service Medal in 1976 and the NASA Distinguished Service Medal in 1988. He was awarded the Presidential Rank of Meritorious Executive in 1980 and the Presidential Rank of Distinguished Executive in 1988.

FORCE

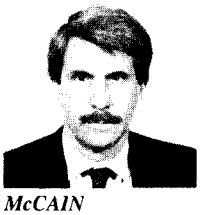
Former Station Director of Goddard's tracking station located in Guam, **CHARLES T. FORCE** has been appointed to head the office of Space Operations, effective July 14, 1989. He succeeds Robert O. Aller in this position.

Force was appointed the Deputy Associate Administrator for Space Tracking and Data Systems in September 1986. He spent ten years in private industry before joining NASA in 1965. Force has accumulated a series of accomplishments in the development, operation and management of NASA's global networks that provide tracking and communications support for NASA missions.

He has received several awards for his career achievements, including the Meritorious Presidential Rank Award, Outstanding Leadership Medal, and the Department of State's Meritorious Honor Award.

CLOSE-UP

HARRY McCAIN, Code 409, was appointed to the position of Project Manager, Flight Telerobotic Servicer (FTS)/Demonstration Test Flight Project, replacing Charles Fuechsel, who transferred to NASA Headquarters. In his new position, McCain is responsible for delivering the FTS flight element to the space station, managing the demonstration test flights, and overseeing the development and management of the FTS test laboratory for system integration, known as the Demonstration, Integration, and Test Facility (DITFAC)...Four Goddard scientists are published in last month's issue of *Tech Briefs* magazine, which features new advances, inventions, and technical issues related to the aerospace industry. **WILLIAM L. MAYNARD,** Code 723.1, contributed information on a process to increase stability of laser diodes under changes of temperature and current...**LEONARD E. KLEINBERG,** Code 728.1, presented a design concept for a crystal-controlled transistor reflection oscillator that is easily tunable and stable, consumes little power, and costs less than other types of oscillators operating in the same frequencies....**PHILLIP R. CHRISTON** and **WALLACE E. MEYER** of Ball Corp. at Goddard have discovered that an optoelectronic system that measures the relative angular position of a shaft or other device to be turned can also measure the absolute angular position after the device has been turned through a small angle...GSFC awarded a cost-plus-award fee contract through the Small Business Administration's Section 8 (a) Program to E.L. Hamm and Associates, Inc., Norfolk, VA, for centerwide plant operations and maintenance services. The five year estimated cost, inclusive of base fee and maximum available award fee, is $32,216,742.



McCAIN

I'm never too busy to donate blood. See you October 4 in the Bldg 8 Auditorium

In Memoriam: Charles Ehrmann

The NASA Exceptional Engineering Achievement Medal was presented posthumously to the widow and family of Mr. Charles H. Ehrmann at a special ceremony at the GSFC Visitors Center on Thursday, August 31, 1989. Former co-workers from the Laboratory for High Energy Astrophysics (Code 660), where Charlie had worked for 26 years prior to his death last year, participated by presenting rememberances of his contributions to scientific instruments flown on balloons, sounding rockets, and spacecraft. Those speaking included Drs. David Bertsch and Bonnard Teegarden (Code 661), Jim Chesney (Code 521.1), and Dr. James Trainor and Dr. Frank McDonald (both code 100). Accepting the award was Mrs. Toby Port-Ehrmann. The Laboratory also presented a scrapbook of memorabilia collected from the approximately 30 flight and ground projects with which Ehrmann was involved between 1962 and 1988, and other momentos of his long and distinguished career at Goddard Space Flight Center. The award was presented by Dr. McDonald, recognizing Ehrmann's "outstanding contributions to the development of spaceflight instrumentation over the past 26 years and for his vital role in the NASA observation of Supernova 1987A".

GIVE

On August 2, the Bloodmobile was held at the GSFC Recreation Center and 160 prospective donors volunteered to donate blood. The visit was a success for the Red Cross and Code 205.2 would like to thank everyone who took the time to donate blood. The following is a list of Goddard donors who were cited by the American Red Cross with gallon pins at the Bloodmobile:

NAME	GALS.	NAME	GALS.	NAME	GALS.
Robert Alelman	2	Jan Michael Hollis	1	Rick Shafer	1
John Baniszewski	3	Ronald Lear	1	Michael Stark	1
David Content	3	Robert Lovisa	7	Richard Starr	8
Scott Glubke	2	Peggy Mackrell	2	David J. Thompson	4
Linda Golding	1	Paul Newman	2		
Mary Gum	2	Wyatt Rinker	5		

Out next bloodmobile is scheduled for October 4 in the Building 8 Auditorium. Watch Dateline Goddard for details.

***SOVIET EXCHANGE*—Fifteen Soviet Union high school students, together with two Soviet Union professors of physics and mathematics spent the day at Goddard on August 7. The students were participants in a program coordinated by the American Association of Physics Teachers, which also arranged for the visit of 17 American students to the Soviet Union. In addition to touring the facilities, the students heard presentations by Goddard's Head of the Laboratory for Oceans Dr. Erik Mollo-Christensen (Code 670), Dr. Michael Desch of the Planetary Magnetospheres Branch (Code 695), and Associate Chief of the Laboratory for Astronomy and Solar Physics Dr. Ted Gull (Code 680). Associate Center Director Dr. James Trainor and several Goddard scientists joined the students at a luncheon at the Goddard Recreation Center.**

NASA Phases Down Guam Tracking Station

by Henry Iuliano

On July 1, 1989, a pioneer tracking station in space exploration, Guam, was retired by NASA to a caretaker status.

NASA authorized the building of the Guam tracking station in 1964. The station first supported project Gemini—one of America's early forays into manned space flight—in 1965. Guam's crowning achievement was its participation and support of one of the world's greatest adventures, that helped realize a 5,000-year-old dream come true—the exploration of outer space and the landing of a man on the Moon twenty years ago on July 20, 1969.

From 1964 until 1989, Guam worked with the world community by being part of a team in the NASA ground network, supporting the many scientific spacecraft and tests that helped realize today's space industry.

The station was built and operated by the Bendix Field Engineering Corporation (BFEC) and is being phased out in favor of new technology—the Space Network, using the three-satellite constellation of Tracking and Data Relay Satellites and the System known as TDRSS.

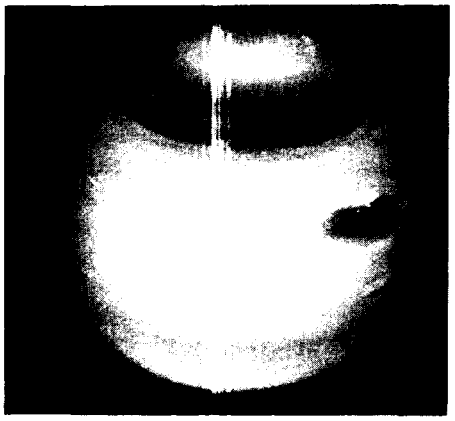
Guam's last support was with Solar Maximum Mission (Solar Max) on June 29, 1989, at 5:30 p.m. EDT (June 30th, Guam time). At the conclusion of the final pass, there were fond farewells from NASA Headquarters.

Present at a ceremony held in the NASCOM area during the final support were Charles Force, former Station Director at Guam and now Deputy Associate Administrator for Space Operations, and Bob Spearing, former Director of Code 500 (Mission Operations and Data Systems Directorate).

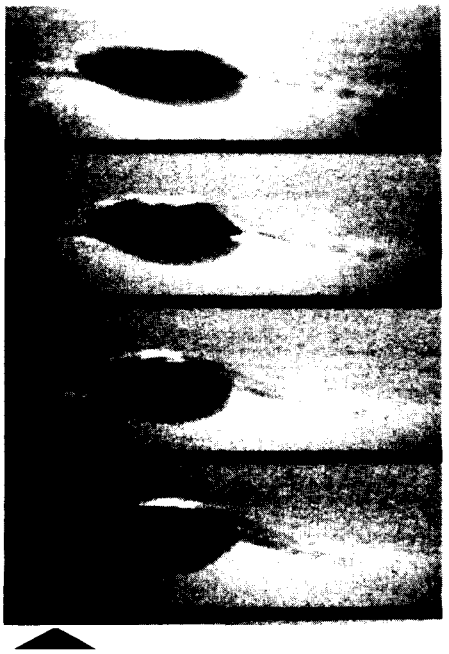
Also present were personnel from the many projects supported by Guam, including several Guam personnel that were relocated to the Goddard Space Flight Center because of this phasedown. Following is a list of new additions to Goddard (and BFEC/Aerospace Building) from the Guam tracking station: John M. Artero (Code 519.1), Leopoldo C. Bacod (Code 519.1), Antanacia A. Caraang (Code 519.1), Lloyd B. Dicke (Code 534), Albert W. Fong (Aerospace Building), Alfred F. Ruerrero (Code 543), Simon E. Lebhar (Code 5534), Manuel P. Lopez (Code 519.1), Johyn R. Meyers (Code 543), Armand E. Pinard (534), Frank A. Ross (531) and Scott P. Selby (519.1).

Voyager 2 Unveils Planet Neptune's Mysteries

Weeks after the Voyager 2 spacecraft's closest encounter with the planet Neptune on August 25, scientists continue to marvel at the wealth of data and images returned by the spacecraft. Scientists will continue to analyze and process the data for months before preliminary results are announced, but images provided by the spacecraft afford a breathtaking perspective of the planet Neptune that all can share.



PLANETARY PROFILE—This extraordinarily clear photograph of the planet Neptune was taken about a week before the Voyager 2 spacecraft's closest encounter. It is one of the rare photographs which show both the planet's mysterious Great Dark Spot as well as another, smaller dark spot near the southern pole of the planet.



DARK CHANGES—This succession of images shows changes in the Great Dark Spot and the clouds surrounding it over a four and one-half-day period. From top to bottom the images show successive rotations of the planet—an interval of about 18 hours. This sequence shows a large change in the western end (left side) of the dark spot, where a dark extension converges into a string of small dark spots over the next five rotations. This "string of beads" extends from the spot at an angle. The large bright cloud at the southern (bottom) border of the spot is a more or less permanent companion of the Great Dark Spot.

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