February is Black History Month

Goddard News

National Aeronautics and Space Administration
Goddard Space Flight Center

Greenbelt, Maryland / Wallops Island, Virginia

Winter 1996 Vol. 43 No. 12

INSIDE

2 Price appointed to post

3 Kicza named Associate Director

4 1995 reviewed

8 NEAR launch near

9 Goddard payloads on STS-72

12 Excellence Award winner named

Diaz new Deputy Director

by Jim Sahli

NASA

Alphonso V. Diaz

Center Director Joseph H. Rothenberg announced in late January that Alphonso V. Diaz had been named Center Deputy Director, effective Feb. 4.

"Al brings to Goddard outstanding management skills and demonstrated leadership of NASA programs. I am personally very happy that Al will be joining Goddard, and look forward to leading the Center together into the 21st Century," said Rothenberg.

Rothenberg defined Diaz's role: "Al will be responsible for Center level management of Space and Earth Science programs. Al's rich experience in program management and strategic planning offer a remarkable complement to the front office."

Prior to this appointment, Diaz was Deputy Associate Administrator for Space Science at NASA Headquarters from 1993 to January 1996. He also served as the Chief Engineer for NASA's Office of Space Science. While at Headquarters Diaz led an effort for the development of plans for the Science Institutes proposed by NASA. His efforts defined the scope and organizational framework of the Institutes.

From 1989 to March 1993, Diaz served as the Deputy Associate Administrator for the former Office of Space Science and Applications (OSSA), where he played a similar role in the management of OSSA's flight programs. From July 1988 to July 1989, Diaz was Division Vice President, Space and Aeronautics Services, for General Electric's Government Services Division in Cherry Hill, N.J.

Diaz received a bachelor of science degree in physics from St. Joseph University, Philadelphia, Pa., and a master of science in physics from Old Dominion University, Norfolk, Va. In addition, Diaz attended the Massachusetts Institute of Technology Sloan School of Management as a NASA Sloan Fellow, where he received a master of science degree in management in 1986. He is an Associate Fellow of the American Institute of Aeronautics and Astronautics.

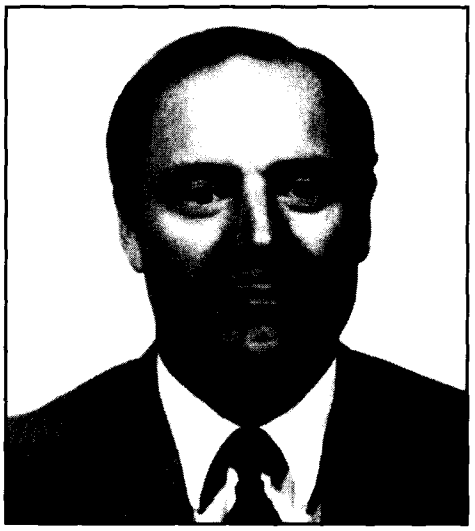
He joined NASA as a co-op student at the Langley Research Center in 1964. He was actively involved in the Viking project from 1969 through 1977 in a variety of roles, including the development and operation of the Viking Gas Chromatograph/Mass Spectrometer. His efforts in support of this mission were recognized in 1977 when he was awarded a NASA Medal for Outstanding Scientific Achievement.

Diaz transferred to NASA Headquarters in 1979 and has served in a variety of positions since then. Aside from the positions mentioned above, he also served as the International Solar-Polar Mission (now Ulysses mission) Program manager, the Galileo Program manager, Manager of Planetary Advanced Programs, and as Deputy Director of the Solar System Exploration Division. He later served as Assistant Associate Administrator for Space Station within OSSA, managing all activities on the use of the planned Space Station for scientific research, providing strategic planning guidance for OSSA's overall program of scientific exploration.

Diaz received a Presidential Rank Award as a Meritorious Executive in 1990, and a NASA Outstanding Leadership Medal in 1994 for his work on the Hubble Space Telescope Project.

Price appointed Associate Director for Mission to Planet Earth

by Allen Kenitzer



Dr. Robert Price

Dr. Robert D. Price, a NASA scientist and Director of the Mission to Planet Earth Office, Code 170, has been appointed as Associate Director of Goddard for Mission to Planet Earth.

The appointment makes Price the senior Goddard official responsible for developing and placing into operation an Earth Observing System (EOS). The goal of EOS is to advance the understanding of the entire Earth as a global environmental system and how the Earth is changing.

Price began his career at NASA in 1967 in what is now Goddard's Laboratory for High Energy Astro-physics, Code 660, as an Aerospace Technologist in Astrophysical Studies. For seven years he performed original and independent research in the field of high energy cosmic radiation. In 1974, he accepted the position of Landsat Investigations Program Results Manager in the Missions Utilization Office of the new Applications Directorate.

After serving an assignment at NASA Headquarters in the Career Development Program during 1977–78, he returned to Goddard, at which time he joined the Information Processing Division of the Mission Operations and Data Systems Directorate, Code 500, where he was responsible for managing the Goddard portion of the NASA End-to-End Data System Program.

In 1980 Price returned to a position in the field of Earth sciences; obtaining the position of Assistant Chief of the Laboratory for Terrestrial Physics, Code 690, with a specific emphasis on the operations and management of the Lab's computing and data facilities. Price moved to the Space Data and Computing Division. Code 930, in 1986 as Associate Chief. He also served as Head of its Science Information Systems Center.

Price was appointed Deputy Director of the Earth Sciences Directorate in 1990. In this position he assisted the Director in the full range of management oversight responsibilities of the Directorate. His major efforts, as the EOSDIS Project Scientist, were to focus and coordinate the directorate's activities in defining and developing the Data and Information System of the Earth Observing System, utilizing his knowledge of both Earth sciences and data systems. He served in this position until April 1993 when he was appointed as Director of the Goddard Mission to Planet Earth Office.

Price received the NASA Exceptional Service Medal in 1990 for his scientific and technical contributions to coordinating and integrating the activities of data system and science groups which have allowed them to advance knowledge of Earth system science.

In addition to his new duties as Associate Director, Price will continue to serve as Director of the MTPE Program Office. This office is responsible for the overall management coordination, program integration,and systems engineering of all Mission to Planet Earth activities, including all of the flight missions, data system, and scientific research in the Earth Observing System Program, and future Earth System Science Pathfinder and special Earth-observing missions.

Born in Essex, Md., Price graduated from Kenwood Senior High school in 1960. He then attended Western Maryland College, where he received a bachelor of science degree in physics and mathematics in 1964; and Catholic University, where he received master of science and doctorate of Philosophy degrees in space science in 1967 and 1974, respectively.

Goddard scientist Carl Fichtel recognized at AAS meeting

The American Astronomical Society (AAS) has selected Dr. Carl E. Fichtel, Code 660, principal investigator of the Energetic Gamma Ray Experiment Telescope (EGRET), to receive the 1995 Bruno Rossi Prize for outstanding contributions in the field of high-energy astrophysics.

Fichtel was recognized for his "key role in the development of the Compton Gamma Ray Observatory mission, for his leadership of the EGRET instrument team, and for the discovery by EGRET of the new class of 'Gamma-ray Blazars'." Fichtel received this honor Jan. 15, at the winter AAS meeting in San Antonio, Texas.

Fichtel joined Goddard in October 1959. After many years of work developing a high energy gamma-ray telescope suitable for space flight, he became the principal investigator on the SAS-2 high-energy gamma-ray telescope which was launched in 1972 and provided a picture of the gamma ray sky, thereby proving the relevant experimental techniques as well as showing the future promise of gamma-ray astronomy. The larger, more sensitive, and more capable gamma-ray telescope EGRET was selected for the Compton

Continued on page 3

Kicza selected Associate Director, Space Science Programs

by Jim Sahli

Debbie McCallum

Mary E. Kicza

Mary E. Kicza has been appointed Associate Director, Space Science Programs at Goddard.

"Mary brings to Goddard a wealth of science program and technology management experience. Her broad understanding of all NASA space science programs makes her the right person for this key position," said Center Director Joseph H. Rothenberg.

She will serve in a dual capacity as the Associate Director for Space Science Programs and Director of the Space Science Program Integration Office. In this capacity, Kicza will be the senior Goddard official responsible for coordinating and integrating all Goddard space science program activities consistent with the Center's leadership within the Agency in astrophysics and space physics.

Kicza has worked at NASA Headquarters since 1987, where she held several positions. Her most recent position was Assistant Associate Administrator for Technology within the Office of Space Science. Before that she served as Deputy Division Director for the Office of Space Science's Solar System Exploration Division.

She was a member of the Microgravity Science and Applications Division (MSAD) within the Office of Space Science and Applications from 1987 through 1993. While in that division, she progressed through several positions, including program manager, Branch Chief for Advanced Programs, Acting Deputy Director and Branch Chief for Flight Programs.

Kicza began her NASA career in 1982 as an electronics engineer at the Kennedy Space Center, supporting the Expendable Launch Vehicles Office. Before joining NASA, she worked as an engineer for the U.S. Air Force supporting Air Force satellite communications programs.

In 1981 she was awarded a bachelor of science degree in electrical and electronics engineering from California State University. She also received a masters degree in business administration from Florida Institute of Technology in 1990.

Kicza is a native of New Mexico and is the daughter of William and Honor Lew of Albuquerque, N.M. She attended St. Pius X High School in Albuquerque.

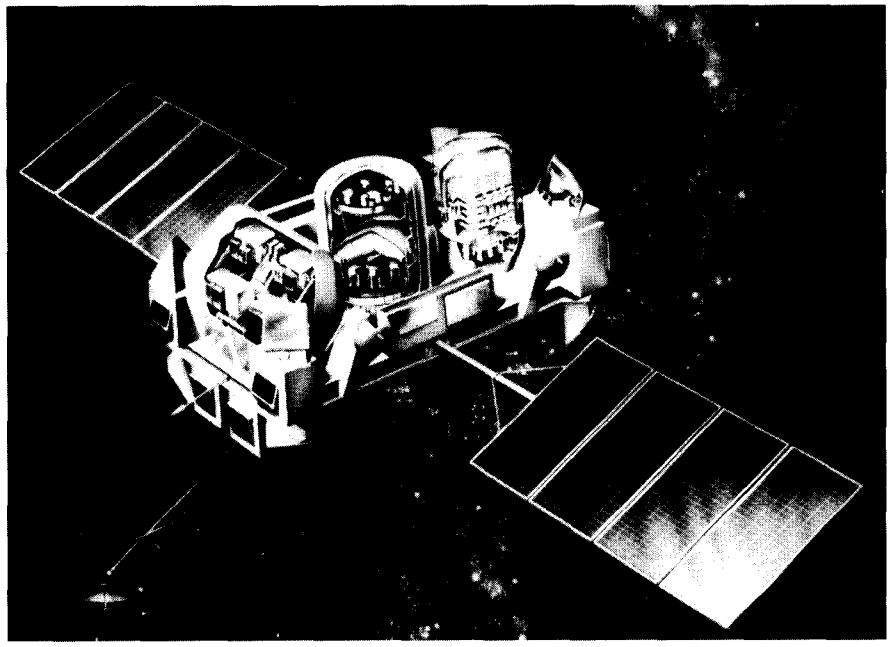
AAS meeting

Continued from page 2

Observatory in 1979. The Compton Gamma-Ray Observatory, consisting of EGRET and three other experiments, was launched by the Space Shuttle Atlantis in April 1991.

The results from the EGRET experiment are well known and cover a wide range of subjects, including active galactic nuclei, solar physics, neutron star pulsars, the galactic diffuse radiation and galactic dynamics, the galactic nature of cosmic rays, the Magellanic Clouds, and gamma ray bursts.

"I am pleased and honored to receive the 1995 Rossi Prize from the American Astronomical Society. I wish especially to commend the very many dedicated people whose contributions over a long period of time made possible the success of the Compton Gamma Ray Observatory in general and EGRET in particular," said Fichtel.



NASA

The Compton Gamma Ray Observatory (CGRO), managed for NASA by Goddard, is a 15-ton spacecraft—the heaviest NASA scientific payload ever built.

Goddard: 1995 in review

by Ernie J. Shannon

Unseasonably warm weather with temperatures in the 50's greeted 1995, a year that brought many changes at Goddard along with a host of achievements in the fields of space exploration and Earth science.

Most significantly, as the new year dawned, NASA announced that the Goddard-managed Upper Atmosphere Research Satellite (UARS) provided convincing evidence that man-made chlorine in the stratosphere is the cause of the Antarctic Ozone hole. The discovery was the culmination of years of research and theory development by researchers around the world.

PaceSetter Award

Early on, to augment the Center's resource development and maintenance, Nancy A. Abell became Deputy Comptroller in the Office of the Comptroller, a newly created position. Abell served as the Resources Management Officer in the Space Science Directorate. Also, early in 1995, Goddard received the PaceSetter Award for the Center's effort to raise more than $400,000 for the 1994 Combined Federal Campaign. The recognition came from the National Capital Area of the Combined Federal Campaign. Topping off the month of January, NASA Headquarters announced the selection of a proposed scientific investigation which includes the development of a new camera for the Goddard-managed Hubble Space Telescope.

Mir Rendevous

The successful performance of two Goddard-managed projects on board STS-63 relieved the chill of February. The Spartan-204 and the Hitchhiker met project managers' goals during the historic mission which included the first rendezvous of the Space Shuttle and the Russian Space Station Mir. NASA discontinued Operations of the Total Ozone Mapping Spectrometer aboard the Russian Meteor-3 spacecraft. This Goddard instrument exceeded its expected life by more than two years delivering important data used to develop maps of ozone levels in the atmosphere. As February ended, Goddard hosted an interactive network presentation called, JASON Project Voyage VI: Island Earth.

This expedition electronically transported students to Hawaiian volcanoes and fields of flowing lava. About 2,400 students and 130 teachers participated in the event. (The 1996 expedition will take students and teachers to the Continental Shelf and the Florida Keys.)

Goddard Telescopes

As the first thaws of winter began in early March, the Center's Deputy Director Tom Huber announced his retirement. After nearly 30 years of hands-on engineering, Huber closed out his distinguished career in Goddard's number two position. In related news, 272 employees applied for buy-out incentives offered by the agency in an attempt to bring employee levels down by the year 2000 to meet White House-mandated restructuring. In space, the Ultraviolet Imaging Telescope distinguished itself on board the Space Shuttle Endeavour during STS-67. Goddard's Dr. Ron Parise joined the STS-67 crew as an astronomer for the mission. This was Parise's second Shuttle flight. In other news, the Hubble Space Telescope continued to deliver new images and information. This month, the telescope identified the presence of an extremely tenuous atmosphere of molecular oxygen around Jupiter's second moon, Europa.

Retirement

The rebirth of spring in April brought significant changes to the Goddard Center. Center Director Dr. John Klineberg retired from the agency after 25 years. He served as Goddard's Director for nearly five years. Joseph Rothenberg, who as Associate Director of Flight Projects for the Hubble Space Telescope, led the first HST servicing mission, was named Deputy Center Director and then Acting Director by NASA Administrator Dan Goldin. Also in April, the Center joined other institutions around the country in celebrating Earth Day. Goddard recognized Earth Day with tree-planting ceremonies, colloquiums, lunch-time seminars and an Earth Science Fair sponsored by the Earth Science Directorate. This year's event marked the 25th year of Earth Day.

In May, the Goddard-managed GOES-J spacecraft successfully launched from the Cape Canaveral Air Station in Florida. GOES-I and J provide vastly improved weather data to forecasters including stunning shots of hurricanes during the 1995 hurricane season. The 1995 season was the most active one in more than 50 years with more than a dozen named hurricanes crossing the Atlantic Ocean. In addition, the first suborbital space payload built and managed by junior and senior high school students was launched on a NASA Sounding Rocket from the Wallops Flight Facility in Virginia. And, final launch preparations began for two major Goddard projects: the TDRS-G satellite and the X-ray Timing Explorer.

Center Director Named

In June, NASA Administrator Dan Goldin directed Goddard to study alternatives to the Orbital Science Corporation's Pegasus XL. The research looked at a number of launch vehicles from the United States and around the world in a comprehensive effort to broaden the agency's launch alternatives in the years ahead. The Goddard Wallops Flight Facility celebrated its 50th anniversary with an open house, tours and other events for the surrounding communities.

In July Acting Center Director Joseph Rothenberg was named Director by NASA Administrator Dan Goldin. Several employees including Dr. Piers Sellers, Earth Science Directorate, who received the Arthur S. Fleming award, and Carol Bleile, and Rex Elliott, both Goddard Procurement employees, who received National Contract Management awards, were recognized during respective presentation ceremonies off-center. The astronauts who will perform space-walking duties for the Goddard-managed second Hubble servicing mission were selected. And the Ultraviolet Imaging Telescope provided images of the starburst galaxy, NGC4736.

Goddard Goes On-Line

Despite a hot and humid August, the pace of activity increased at the Center. The Goddard Public Affairs Office launched a new World-Wide-Web-Homepage (http://pao.gsfc.nasa.gov/.) on the Internet, making the story of Goddard readily available to the general public. Preparations continued for the second Hubble Servicing Mission in 1997. Goddard engineers performed inspections of the replacement Fine Guidance System Radial Bay Module and sent it to Hughes Danbury Optical Systems for "bake out." Although an ambitious in-house effort, this process is more efficient and cost-effective than

Continued on page 10

SOHO/XTE launched successfully

by Jim Sahli

Goddard engineers and scientists have been busy maintaining two new spacecraft that were launched during December. Teams from Goddard traveled to Cape Canaveral Air Station (CCAS), Fla. to participate in the launch of the Solar and Heliospheric Observatory (SOHO) and the X-ray Timing Explorer (XTE).

SOHO spacecraft operations are running well after a successful launch Dec. 2, 1995 at 3:08 a.m. EST from CCAS. The SOHO spacecraft will soon reach its eventual Halo orbit where it will gather scientific information about the sun for NASA and the European Space Agency (ESA). The launch of the SOHO observatory aboard a Lockheed Martin Atlas IIAS rocket occurred at Launch Complex 36-Pad B.

On Dec. 3, the spacecraft executed successfully an initial planned thruster burn or midcourse correction to further guide the SOHO spacecraft to its eventual Halo orbit 937,000 miles from Earth toward the Sun. A midcourse correction maneuver on Jan. 4 further refined SOHO's trajectory, said Ken Sizemore, manager of the International Solar Terrestrial Physics Project Code 407.

SOHO's 12 scientific instruments are currently being tested. Scientists are studying the first images and calibrating their instruments for the start of regularly scheduled operations in late March. The spacecraft's particle detectors have been operational for some time and SOHO's first image of the Sun was taken before Christmas, on Dec. 19 by the MDI instrument. Data from this device will allow scientists to listen to sound waves reverberating inside as well as just below the surface of the Sun.

Almost all of the instruments already have begun to get data on the Sun and heliosphere. New images and spectra of the Sun's outer atmosphere have been obtained. A first image of the far corona shows vivid detail, and a first ever picture of interstellar hydrogen interacting with the heliosphere has been obtained. Scientists expect to present their initial findings to the public by early May.

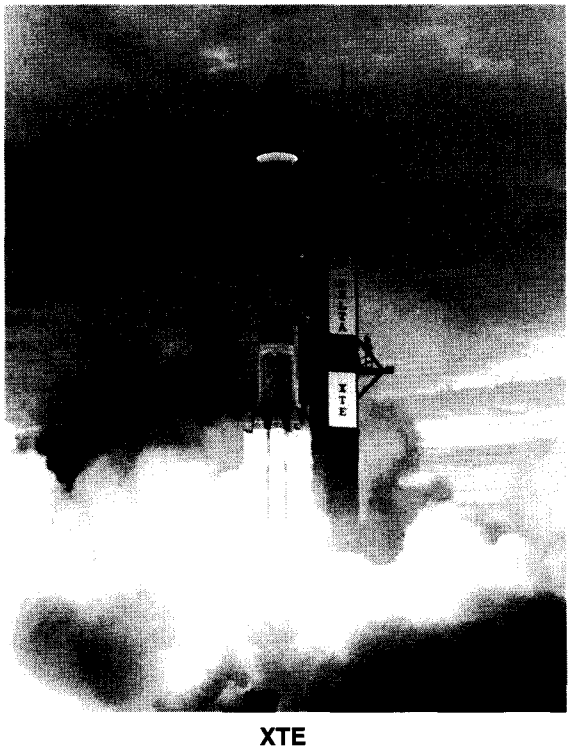
NASA

SOHO

The preliminary observations are very exciting according to U.S. Project Scientist, Dr. Art Poland, Code 682.

SOHO is a project of international cooperation between NASA and ESA. The mission is part of the International Solar Terrestrial Physics Program. SOHO will provide data in concert with other spacecraft for a global observation of the Sun and its influence on Earth's environment.

Meanwhile, NASA's X-Ray Timing Explorer (XTE) has concluded its engineering checkout and the science team is now conducting a calibration of its science instruments before commissioning the spacecraft for full-time science research this month.



NASA

XTE

"We are checking out the spacecraft instruments and mapping out the particular space environment of our orbit under current conditions. The densities of energetic electrons and protons determine when our instruments can safely operate and obtain good data," said Dr. Jean Swank, XTE project scientist, Code 666.

Spacecraft officials have indicated that they are monitoring several spacecraft anomalies at this time. All are stable after the first month of operation and represent no impact to the operation. A loss of solar array power is the most serious one. Engineers say that the science objectives can be met with the existing power generation capability.

The satellite was launched Dec. 30 at 8:48 a.m. EST from the Cape Canaveral Air Station in Florida. The satellite was placed into a circular 360 statute mile (580 kilometer) orbit with an inclination of 23 degrees by a Delta II launch vehicle.

NASA scientist receives prestigious John Scott Award

by Jim Sahli

NASA

Dr. John Mather

A senior astrophysicist at Goddard joined the company of Madame Curie, the Wright Brothers and Jonas Salk, when he was honored for his space science research.

Dr. John C. Mather, Code 685 received the prestigious John Scott Award at a November ceremony, at the American Philosophical Society (APS) in Philadelphia, Pa.

The advisory committee that selected Mather said: "Dr. John C. Mather, a graduate of Swarthmore College and a scientist at NASA's Goddard Space Flight Center, is recommended for his achievements in the field of cosmology. His measures of the spectrum of the cosmic microwave background radiation and the detection of minute temperature fluctuations in this radiation have confirmed predictions of the Big Bang model of the early universe. He was the scientific leader of the Cosmic Background Explorer (COBE) project."

Mather, upon learning of the award, said "I am extremely thankful for the contributions of others. The work being recognized was made possible by the combined efforts of a large team of dedicated managers, scientists, engineers, technicians, accountants, secretaries and many other professions located primarily at the Goddard, at six major universities, the Jet Propulsion Laboratory, and private businesses.

"I am pleased to be recognized personally. COBE is something I have been working on since graduate school. I organized the scientific group that proposed the COBE satellite back in 1974, when I was just out of graduate school, and have been leading that effort ever since.

"The COBE was designed to measure the cosmic background radiation from the beginning of the entire Universe, around 15 billion years ago. We measured the spectrum of the radiation and showed that it fits the Big Bang theoretical predictions extremely well; the theory passed its toughest test yet," said Mather.

"We discovered that the radiation is not uniform, but has hot and cold spots that probably originated in quantum mechanical processes in the very hot and dense early Universe. The cold spots are thought to be the dense regions that would eventually develop into galaxies and clusters of galaxies," he said.

Although NASA stopped operating the satellite in January 1994, the researchers are still analyzing the data with computers and computer simulations of the early universe.

The John Scott Award is given to "the most deserving" men and women whose inventions have contributed in some outstanding way to the "comfort, welfare and happiness" of mankind. In this century, most of the awards have gone to contributors to science and medicine. Awards have recognized significant contributions in prevention of yellow fever and malaria, and in the development of penicillin and streptomycin.

The donor, John Scott, was an Edinburgh druggist who in the early 1800s set up a fund calling upon the "Corporation of Philadelphia entrusted with the management of Dr. Franklin's legacy" to bestow upon "ingenious men or women who make useful inventions" a cash award and a suitably inscribed copper medal. Mather received $7,500 for his achievement, as well as a certificate.

When asked what first interested him in Space Science, Mather had this response.

"I always wanted to know how human beings got here, how the universe started, how stars and planets formed, and how life originated, ever since I was a small child. I remember visiting the Museum of Natural History in New York City in 1953, when I was seven years old, and Mars was especially close to Earth. I saw the planetarium show and the great iron meteorite and thought it was wonderful," said Mather.

"My parents read to me excerpts from the biographies of Galileo and Darwin when I was seven or eight, and I read the rest myself. I was enchanted with the whole idea of scientific research,"

Mather received a bachelor of arts degree in Physics with highest honors from Swarthmore College (near Philadelphia) in 1968. He received his Ph.D. in Physics in 1974 from the University of California at Berkeley.

The NASA scientist has received six non-NASA awards and honors since graduate school in addition to the John Scott Award. Mather has published more than 50 technical articles on his research.

Mather and his wife, the former Jane Hauser of New York City, live in Hyattsville, Md. His father, Dr. Robert Mather, was a geneticist and his mother, Martha Mather, was an elementary school teacher. They both have retired and are living in East Brunswick, N.J. His sister, Janet Mather, lives in the Chesnut Hill neighborhood in Philadelphia.

Marc DeBord

The James Kerley Award goes to Vranish

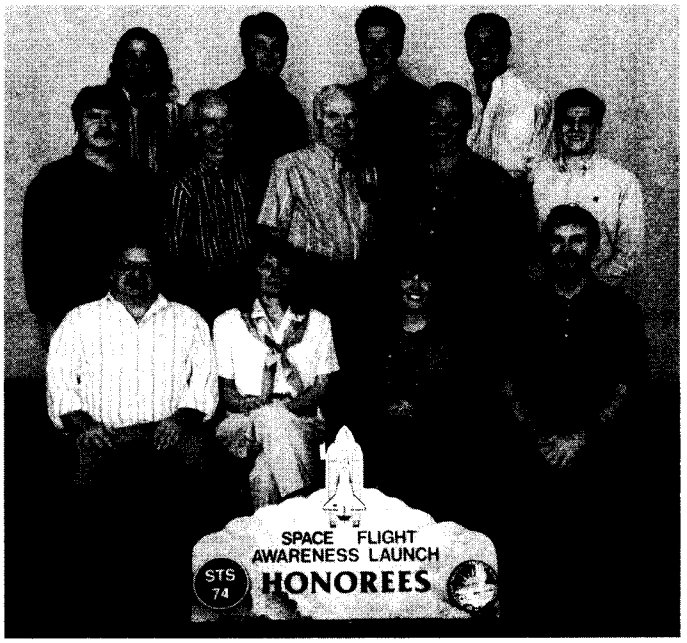
Dr. George Alcorn, Chief of the Office of Commercial Programs, Code 702 presents the James Kerley Award to John Vranish (Code 723.4). The award is given annually to a GSFC innovator who has greatly contributed technologies that will enable commercial opportunities. The award is named after the late Goddard scientist. Vranish also was the recipient of four patent awards, including technologies for the Split Spline Screw, Electromagnetic Brake/Clutch Device, Spline Screw Payload Fastening System, and the Capaciflector Camera.

Space Flight Awareness Launch Honorees

Fifteen Space Flight Awareness (SFA) Launch Honorees from Goddard were among the VIP's at Kennedy Space Center's Banana Creek viewing area to witness the Nov. 12 STS-74 launch of Space Shuttle Atlantis. In addition to a reception held in their honor at the Port Canaveral Cruise Terminal, activities included a VIP tour of KSC and an afternoon social held outdoors at KARS Park. The Goddard honorees were presented a certificate and pin by Astronaut Bill Gregory.

This NASA-sponsored award recognizes individuals for their exceptional dedication to quality work and flight safety. It is one of the highest and most prestigious awards available to employees of the NASA/industry Space Shuttle/payloads team.

The next Space Flight Awareness Launch Honoree Event will be held in late March 1996 for the STS-76 mission.



NASA

Honorees pictured left to right: First row: Larry E. Greer/AlliedSignal Technical Services Corporation (ATSC); Linda Abramowicz-Reed/Hughes Danbury Optical Systems, Inc.; Lori K. Baxter/Computer Sciences Corporation (CSC); Gerard W. Durback/Code 741; second row: Carl H. Barrow/CSC; Fred G. Pifer, Jr./ATSC; Carroll H. Clatterbuck/Code 313; Scott M. Allen/ATSC; Gregory T. Dell/CSC; third row: David J. Israel/Code 531; David L. Pierce/Code 831; Mark A. Blair/Lockheed Martin Technical Operations Company (LMTOC); and Michael L. Weiss/Code 442. Not available for photo: John G. Hagopian/Code 717 and Philip Blower/LMTOC.

Retirees

Congratulations to the following employees who recently retired!

Name	Code	Years
Bertrand Johnson, Jr.	924	39
Henry Miller	735.2	38
John Balla	733.4	36
John Paulkovich	734	36
Ewald Schmidt	701	32
John Bauernshub, Jr.	421	32
Philip Davis	900	31

Discovery Program gets underway with launch of NEAR

The Near Earth Asteroid Rendezvous (NEAR) mission is the first launch in the Discovery Program, a NASA initiative for small planetary missions with a maximum three-year development cycle and a cost capped at $150 million. The NEAR mission is managed for NASA by The Johns Hopkins University Applied Physics Laboratory (JHU/APL).

As the first spacecraft to orbit an asteroid, the NEAR mission promises to answer fundamental questions about the nature and origin of near-Earth objects, such as the numerous asteroids and comets in the vicinity of Earth's orbit. These objects are of interest for several reasons. They are the primary source of large bodies that collide with Earth, greatly influencing the evolution of the atmosphere and life on Earth. An asteroid collision with Earth was likely responsible for the mass extinction at the end of the Cretaceous period, and another impact in 1908 destroyed thousands of square kilometers of forest near Tunguska, Siberia.

In addition, clues to the nature of early solar system processes and conditions are preserved in various forms on small bodies like asteroids, comets, and meteorites. These records have been altered or destroyed on large, planet-sized bodies by processes of planetary evolution. The near-Earth population of asteroids, in particular, is believed to contain clues to the nature of the building blocks ("planetesimals") from which the inner planets, including Earth, were formed.

Two of the instruments on this spacecraft have Goddard scientists leading the science effort.

Dr. Jacob I. Trombka of Goddard's Laboratory for Extraterrestrial Physics, Code 690 is leading the science team associated with the spacecraft's X-ray/gamma-ray spectrometer (XGRS). The XGRS, one of five major facility instruments on the NEAR spacecraft, is the primary experiment for determining surface/near-surface elemental composition of the near-Earth asteroid 433 Eros. XGRS measurements are fundamental to solving such mysteries as the source of meteorites and their relationship to asteroids. XGRS, built by the JHU/APL to NASA specifications, consists of two state-of-the-art sensors: an X-ray fluorescence spectrometer and a gamma-ray spectrometer. Redundant solar monitors are used to determine the incident solar X-ray spectrum.

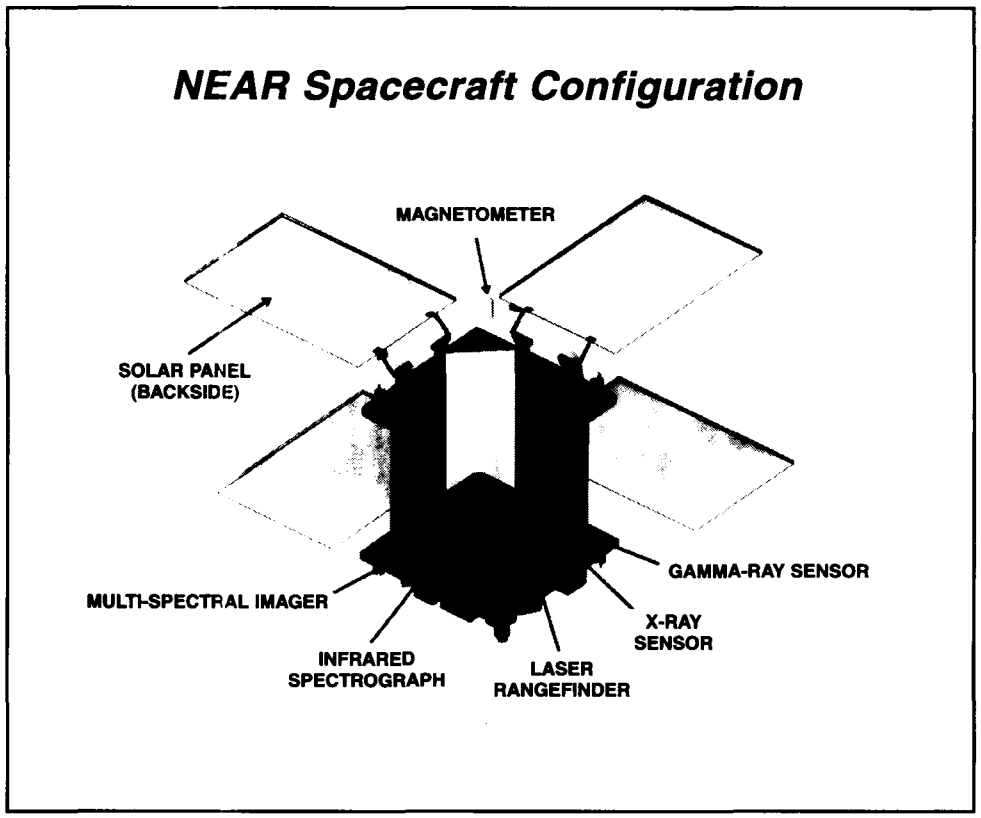
"The XGRS basically is going to study the global chemistry of a planetary surface and in turn map all the chemistry of the asteroid's surface," said Trombka. "These samples will let us understand the evolution of the planet's surfaces."

NEAR's Magnetometer Investigation will conduct the first closeup search for coherent bodywide magnetism at an asteroid. Leading this science effort will be Goddard's Dr. Mario Acuna from Code 690. Tantalizing hints of magnetic signatures were detected during Galileo's flybys of Gaspra and Ida, so 433 Eros may have a measurable magnetic field.

The NEAR spacecraft is scheduled to rendezvous with Asteroid 433 Eros Feb. 6, 1999. The end of the mission is scheduled for Dec. 31, 1999.

Goddard engineers and technicians conducted final environmental testing prior to its Dec. 6 shipment to the Cape Canaveral Air Station, Fla.

The spacecraft is scheduled for launch on a McDonnell Douglas Delta II launch vehicle from the Cape Canaveral Air Station at 3:53 p.m. Feb. 16. The Delta II program is managed by the Goddard Orbital Launch Services project, Code 470.

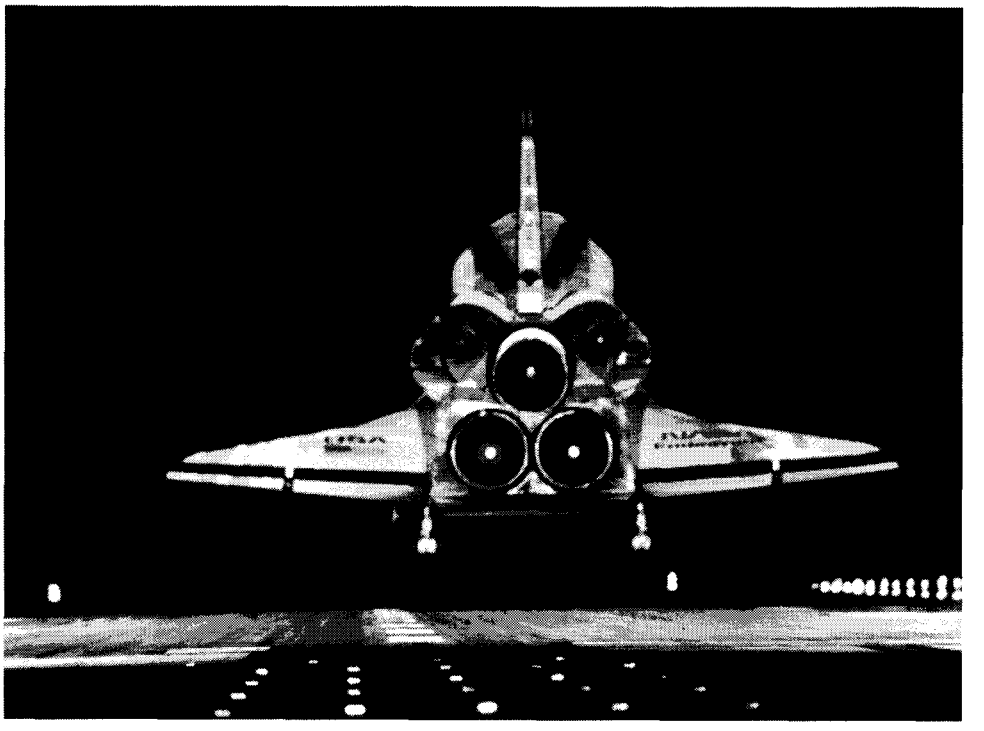


NASA

This illustration shows the Near Earth Asteroid Rendezvous (NEAR) spacecraft. Two Goddard scientists from Code 600 will use their NEAR instruments to study the asteroid when the spacecraft reaches Eros in 1999. The two Goddard instruments are the X-ray/Gamma-Ray Spectrometer and the Magnetometer.

Three Goddard projects Fly on STS-72

Three projects managed by Goddard were on the manifest for Mission STS-72 which flew last month. One of them, the Shuttle Backscatter Ultraviolet Experiment (SSBUV), made its final Shuttle flight.



NASA

Space Shuttle Endeavour completes Mission STS-72 by making the eighth night landing since the Shuttle program began in 1981. A highlight of the mission was the retrieval of the Goddard's OAST-Flyer.

OAST-Flyer

OAST-Flyer was a primary payload, and the seventh Spartan to fly on a Shuttle. It was made up of four experiments: REFLEX, GADACS, SELODE, and SPRE. Two of the four experiments, REFLEX and GADACS, were sponsored by the Office of Aeronautics and Space Technology. SELODE was sponsored by the Office of Safety and Mission Assurance (OSMA) and the fourth experiment, SPRE, was a volunteer effort comprised of University of Maryland students, area engineers, and space industry contractors.

The Spartan Project

The Spartan spacecraft is a small, rectangular, free-flying vehicle, measuring roughly 1 x 1.25 x 1.5 meters. It is released from the shuttle and picked up after several days of conducting its experiments.

The Spartan Project is managed by Goddard's Special Payload's Division, Code 740. More information on the Spartan Project and its payloads is available on the Internet at the following address:http://sspp.gsfc.nasa.gov/home740 .html.

SLA-01/GAS(5)

The Shuttle Laser Altimeter-01/Get Away Special (5) [SLA-01/GAS(5)] payload is a Goddard Shuttle Small Payloads Project (SSPP), Code 740.3 payload. SLA-01 is managed by the Hitch-hiker Program. Four of the five canister payloads are managed by the GAS Program with one being a ballast payload, the fifth is a Complex Autonomous Payload. SSPP has responsibility for the mission management, safety, payload integration, and mission operations of the SLA-01/GAS(5) payload. During the nine day mission, the Hitchhiker Avionics provided real-time commanding and downlink capabilities to SLA-01. The crew activated and deactivated the GAS and CAP payloads via a laptop computer located in the aft flight deck. More information about the SLA-01/GAS(5) payload can be found on the World Wide Web site: http://sspp. gsfc.nasa.gov/sla-01.html.

SSBUV

In late 1989, the Space Shuttle Atlantis carried the first flight of NASA's Goddard Space Flight Center's Shuttle Solar Backscatter Ultraviolet (SSBUV) instrument. Since then, SSBUV has made six additional flights and has become fondly known as Goddard's "frequent flyer." SSBUV flew for the eighth and last time aboard STS-72.

The SSBUV instrument was developed at Goddard and is designed to measure ozone concentrations by comparing solar ultraviolet radiation with radiation scattered back from the Earth's atmosphere.

SSBUV compares its results with the observations of several ozone measuring instruments both past and present aboard NASA's Nimbus-7 and the National Oceanic and Atmospheric Administration (NOAA)-9, NOAA-11 and NOAA-14 satellites, the Russian Meteor-3/TOMS satellite, Goddard's Upper Atmosphere Research Satellite (UARS), and the European Space Agency's ERS-2 satellite, which was launched in April 1995. The SSBUV data are used to calibrate the instruments to ensure the most accurate readings possible for the detection of atmospheric ozone trends.

SSBUV undergoes rigorous calibration before and after flight. Consequently, scientists can determine the reliability of ozone data gathered by other satellite instruments. The SSBUV uses the Space Shuttle's orbital flight path to assess performance by directly comparing data from identical instruments aboard the NOAA spacecraft as the Space Shuttle and the satellites pass over the same Earth location within an hour. These orbital coincidences can occur 17 times a day.

Goddard: 1995 in review

Continued from page 4

performing the task elsewhere. Goddard technology helped save the lives of eight people during a hurricane this month. The Search and Rescue Satellite Aided Tracking or SARSAT instrument, received a signal from an activated beacon aboard a casino cruise ship that was stranded and sinking in bad weather. The U. S. Coast Guard responded and saved the lives.

In September, Goddard began implementing a standards-based electronic mail infrastructure. The Information Resource Oversight committee agreed to provide a solution to standardize e-mail on an open systems based upon research and recommendations from around the Center. The Goddard community outreach efforts received a boost with the Goddard Fall Community Day at the Visitor Center. Preston Burch of the Flight Projects Directorate gave a special demonstration on Hubble Space Telescope operations. More than 4,000 people attended this semi-annual event.

Data Transfer

On Oct. 1, Goddard transferred control of the International Ultraviolet Explorer to a partnership of the European Space Agency and the Particle Physics and Astronomy Research Council of the United Kingdom. Goddard provided nearly two decades of continuous operations support. Managers of the Upper Atmosphere Research Satellite announced that, for the first time, American satellite data was relayed to a foreign satellite, the Japanese Engineering Test Satellite. The effort was successful and, as a result, managers plan similar transfers of data in the future.

Launch Success

November proved to be a very busy month starting with the launch of the Space Shuttle Atlantis on a second docking mission with the Space Station Mir. During the mission, Atlantis carried the Goddard-managed Hitchhiker payload in its cargo bay. NASA selected the Center's Pistol Grip Tool to be the extravehicular activity power tool provider for International Space Station Alpha. Goddard engineers developed the tool for the second Hubble Space Telescope servicing mission. Speaking of the Hubble Space Telescope, images titled "Star Birth in the Eagle Nebula" proved to be the most dramatic pictures yet taken by the Telescope. And the first "snapshot" of the spiral structure of the solar system's magnetic field was generated by the Ulysses spacecraft. Finally, Dr. Robert Price became Associate Director of Goddard for Mission to Planet Earth. This appointment made Price the senior Goddard official responsible for developing and placing into operation an Earth Observing System.

In December, NASA launched the Solar and Heliospheric Observatory (SOHO). SOHO is a mission of international cooperation with the European Space Agency. In addition, the X-ray Timing Explorer launched from Cape Canaveral Air Station aboard a McDonnell Douglas Delta rocket. Closing out the year, NASA Administrator Dan Goldin came to Goddard in mid-December and had praise for the Center's science and engineering endeavors. The NASA Administrator visited various Goddard facilities and expressed "amazement and delight" with the technological achievements by Goddard scientists, engineers and technicians.

In other activities that lasted throughout 1995, the advancement and application of new Goddard technologies became a Center priority. While meeting mission goals, technologies developed at Goddard have placed the center at the forefront of technological innovation. Last year, Goddard excelled in development and advancement of technology within cryogenics, fiber optics, detectors, data compression, spacecraft communications and ground systems.

Significant changes are occurring in Goddard's culture and management structure with the completion and implementation of the Zero-Base Review results. Based on these, Goddard is restructuring by reducing its infrastructure and looking for more efficient ways to do business. The goal is to cut infrastructure costs without impacting programs. The outcome leaves Goddard with its current programs intact, new initiatives on the horizon such as the New Millennium Earth System Science Probes programs, and better enabling science research and development.

Finally, as a fitting wrap-up of 1995, Center Director Joe Rothenberg appointed Dot Zukor, who serves as the Deputy Director in the Earth Sciences Directorate, to head a strategic planning team. During the first of this new year, Zukor's team will lead the Center as employees and managers examine what Goddard's "road map" for the future should be. The key issues that will be resolved are the values that will guide the Center, the mission that Goddard will accomplish, and the strategies that will guide the decisions. The process will be an active one that involves all levels of the Center.

Strategic Planning Team

Lead: Dot Zukor
100 – Wayne Boswell
***Backup for Human Resources*–Jerry Simpson**
***Backup for Facilitation*–Stacy Day**
***PAO*–Allen Kenitzer**

Nancy Abell
***Backup*–Curtis Johnson**

200–Krista Pacquin
***Backup*–Marilyn Toliver**

300–Jay Garvin
***Backup*–Jack Shaw**

400–Orlando Figueroa
***Backup*–Peg Luce**

500–Dolly Perkins
***Backup*–Vicki Pendergrass**

600–Neil Gehrels
***Backup*–Susan Neff**

700–Mitch Brown
***Backup*–Alda Simpson**

800–Holland Bell
***Backup*–Bruce Underwood**

900–Tony Busalacchi
***Backup*–Chester Koblinsky**

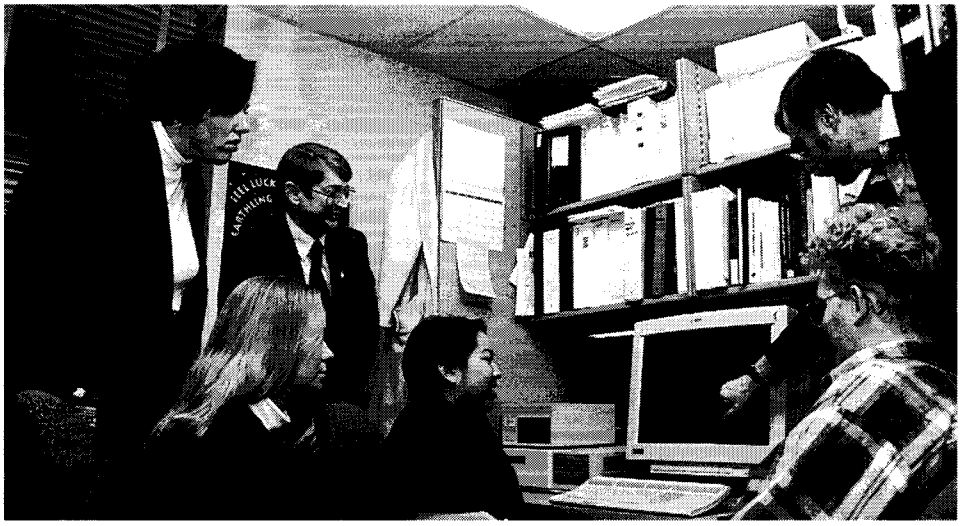
International Ultraviolet Explorer Education Project

Area high school and college students are part of a program that allows for the continuation of certain IUE operations.

Shown here in the photo from left are Isabel Rahe (seated), a junior at Stone Ridge High School; Katherine Keilty, a senior at Catholic University of America; Dr. Terry Teays, Computer Sciences Corporation, Code 681, Program Instructor; Patricia Chow, a senior at Walter Johnson High School; Professor Fred Bruhweiler, Catholic University of America and David Kolesar, a freshman at Catholic University of America.

According to Dr. Yoji Kondo, the IUE Project Scientist, Code 684, the program provides hands on experience for young students, who also earn extra credit for their work at Goddard.

This program demonstrates a new approach, in which students operate a spacecraft and obtain valuable data for scientific analysis. It will make possible timely observations of exciting pheonomena like Comet Hale-Bopp, which may become the brightest comet of the century.



Marc DeBord

IUE Student Operations

In October IUE science operations were turned over to the European Space Agency. NASA through Goddard continues to provide limited satellite operation support. IUE was launched in January 1978 and still is one of the most productive telescopes in the world.

Polar launch completes Global Geospace Science program missions

NASA's Polar spacecraft, scheduled for launch in February from Vandenberg Air Force Base (VAFB), Calif., is a key element of a constellation of satellites which promise to revolutionize understanding of the Sun's influence on Earth's space environment.

The final mission in NASA's Global Geospace Science (GGS) program, the Polar laboratory will be launched in an orbit which loops high over the Earth's poles for a three-year mission to study the movement of energetic charged particles above the polar regions. It will give scientists new perspectives on how Earth's space environment is affected by continual bombardment from radiation and particles from the Sun, data which eventually could help scientists forecast "space weather".

"Polar will help us in a new area of research that scientists call 'space weather' where the objective is to make relevant observations of our solar-terrestrial system. Then, we will put these data into models that will predict where and when various types of space disturbances will occur," said Dr. Robert Hoffman, Polar Project Scientist, Code 696. "Information from Polar about the radiation environment that satellites and spacecraft experience will enable the development of better radiation-tolerant technology for space systems."

The Polar laboratory will perform simultaneous, coordinated measurements of the key regions of Earth's geospace, or space environment, with WIND, which was launched November 1994 and is now measuring the solar wind properties. A large array of ground-based scientific observatories and mission-related theoretical investigations also will be involved.

NASA is collaborating with the European Space Agency (ESA) and the Japanese Institute of Space and Astronautical Sciences (ISAS) in three additional solar-terrestrial missions, Geotail, SOHO and Cluster. These missions, together with GGS, make up the International Solar Terrestrial Physics (ISTP) science initiative.

"The aim of ISTP is to understand the physical effects of solar activity on interplanetary space and the Earth's space environment. This will lead to the capability of predicting the responses of each part of the Sun-Earth system to solar activity," said Dr. Mario Acuna, ISTP Project Scientist, Code 695.

Information about the Polar mission and the ISTP are available on the Internet at the following locations:

Polar:
http://www-istp.gsfc.nasa.gov/ISTP/ggs_project.html

ISTP:
http://www-istp.gsfc.nasa.gov/

Goddard is managing the Polar project for the Office of Space Sciences at NASA Headquarters in Washington, D.C.

Goddard Excellence Award recipient named

by Gene Guerny

In December 1995, during the Goddard Contractors Association's annual Continuous Improvement Symposium, Center Director Joseph H. Rothenberg announced the winner of the 1995 Goddard contractors Award for Quality and Productivity.

The winner, McDonnell Douglas Aerospace-Space and Defense Systems Engineering Services Division of Seabrook, Md., received the trophy during a formal presentation in January. There were three finalists vying for the award. They were the McDonnell Douglas Division, Lockheed Martin Missiles and Space, NASA & Federal Systems and Research and Development Division of Sunnyvale, Calif., and Space Systems/Loral of Palo Alto, Calif. The Lockheed Martin and the Loral companies received finalists plaques during the ceremony. The event was the eighth annual Goddard award ceremony for its contractors.

The award is given to recognize those companies that make a substantial contribution to the mission of GSFC.

Jerry Allen (center), General Manager McDonnell Douglas, Engineering Services Division, Seabrook, holds the 1995 Goddard Excellence Award Trophy as (left to right) Jerry Simpson, Code 113; Joe Rothenberg, Center Director; Vern Weyers, Code 400; James McPherson, McDonnell Douglas; Daniel Hinz, McDonnell Douglas; Richard Long, McDonnell Douglas and Robert Laurenson, McDonnell Douglas look on.

Goddard News

National Aeronautics and Space Administration — Goddard Space Flight Center

The GODDARD NEWS is published monthly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

Deadline to submit material is the first of each month For additional information contact Fred Brown (301) 286-8955.

The GODDARD NEWS Staff is:
Executive Editor: Jim Sahli
Managing Editor: Fred Brown
Contributing Editors: Donna Drelick, Tammy Jones, W. Allen Kenitzer, Ernie J. Shannon

Red Cross Bloodmobile

The Red Cross Bloodmobiles were held on Dec. 6, 1995 and Feb. 7. The next Bloodmobile will be held on April 3, in the building 8 auditorium. Watch DATELINE and ccmail for details.

Following is a list of employees who made the gallon mark:

	Gallons
Leonard Brown	7
Andrew Szymkowiak	7
William Anselm	6
Joseph Young	4
Carolyn Dent	4
Charles Divine	4
Bernard Klein	3
Herman Williams	1
Timothy Gruner	1
Edward Chang	1
Wayne Eklund	1

March is Women's History Month

National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

March 1996 Vol. 43 No. 13

INSIDE

2
New feature: Director's Update

4
Pluto's surface revealed

6
Goddard engineer astronaut candidate

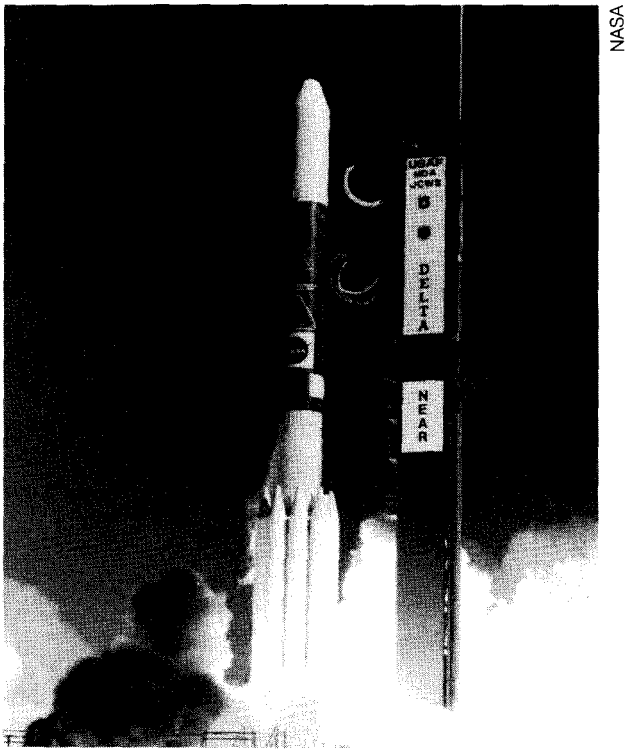
8
JASON Project VII

Near Earth Asteroid Rendezvous spacecraft flies with Goddard instruments

The Near Earth Asteroid Rendezvous (NEAR) spacecraft has embarked on a journey that will culminate in a close encounter with an asteroid. After a one-day delay, a Goddard-managed Delta II expendable launch vehicle lifted off at 3:43 p.m. EST, Feb.17 from Pad B at Launch Complex 17 on Cape Canaveral Air Station in Florida carrying the NEAR spacecraft.

The NEAR spacecraft's design emphasizes simplicity, reliability and lower cost. Its science payload includes two Goddard instruments: an X-ray/gamma ray spectrometer and a NEAR magnetometer. Other instruments include: a near-infrared spectrograph, laser rangefinder, and multispectral imager.

The launch of NEAR inaugurates NASA's innovative Discovery program of small-scale planetary missions with rapid, lower-cost development cycles and focused science objectives. NEAR will rendezvous in 1999 with the asteroid 433 Eros to begin the first long-term, close-up look at an asteroid's surface composition and physical properties. The NEAR mission is managed by The John Hopkins University Applied Physics Laboratory (JHU/APL) for NASA's Office of Space Science at NASA Headquarters.



NASA

The NEAR spacecraft on its way moments after its launch from the Cape Canaveral Air Station.

Polar in an elliptical orbit

by Jim Sahli

NASA's newest space physics laboratory is performing well on orbit. Polar was launched successfully from Vandenberg AFB in California at 6:24 a.m. EST Feb. 24, on a Delta II rocket and is in an elliptical polar orbit.

"As of day 12, we have raised perigee using onboard propulsion and powered on all but two of the Polar instruments. Mission operations continue to hum right along on schedule," said Dr. Bob Hoffman, the Polar Project Scientist at Goddard.

Polar is the latest spacecraft in NASA's Global Geospace Science mission series, which is part of the International Solar-Terrestrial Physics (ISTP) program. Polar and a sister spacecraft, Wind, are slated to perform simultaneous, coordinated measurements of key regions of Earth's space environment, including observations of entry and transport of solar plasma over Earth's magnetic poles, imaging of the northern aurora (Northern lights) and investigations of solar wind properties. Wind was launched in November 1994.

The Polar spacecraft carries 11 instruments. Currently it is in an elliptical orbit with an apogee of 32,000 statute miles and a perigee of 3,200 statute miles on a polar path inclined 86 degrees from the equator.

The satellite is a spin-stabilized cylinder-shaped spacecraft 7.9 feet in diameter and 6.9 feet high excluding

Continued on page 5

Director's Update

by Joe Rothenberg

Editor's note: *What follows is a column written by Center Director Joe Rothenberg. It replaces the Director's Dialogue column in the Goddard News. Employees with Director's Dialogue questions may continue to submit them to the Office of Public Affairs, Code 130. Questions submitted should include mail code address or e-mail address so that employees can receive a response.*

Beginning with this issue of the Goddard News, I will use this space to update you on what's happening around the Center. I hope that the information it contains will help to keep you informed about the exciting things going on at GSFC.

The successful launches of the SOHO, Polar and RXTE spacecraft over the past several months have provided the space science community with new tools to study both the sun Earth connection and the X-ray sources emanating from the universe.

The Mission to Planet Earth program continues to progress well. The instruments for the TRMM spacecraft are currently being integrated proceeding toward a fall 1997 launch. The EOS AM Platform is on schedule for a 1998 launch and the first Earth System Science Probe Announcement of Opportunity is scheduled to be released this spring. On the new initiative front, Center scientists and engineers working with the community, are actively pursuing scientific and technology questions for the Agency which will lead to future Goddard-sponsored missions. As one example, a Goddard led team is currently studying the next generation Space Telescope.

Along with our mission activities, strategic planning activities that will shape the future of the Center are well underway. These activities are critical to carry out our mission within the current and future budget environment as well as develop a constituency who will truly view Goddard as a national resource. The strategic planning activities are encompassed in three major efforts: near term "Strategic Roadmap" actions to refocus of the Goddard workforce into a hands-on technology leadership role; a Center Strategic Plan Development activity led by Dr. Dorothy Zukor to establish the plan to ensure GSFC maintains and enhances its leadership as the NASA Center of Excellence for Scientific Research; and the development and commitment of the Center to a set of programmatic goals designed to enable significant improvements in the cost effectiveness of our missions.

These three activities represent ambitious efforts and will provide exciting challenges for Goddard. They will involve most of the GSFC workforce over the next several years and more importantly ensure that the Goddard Space Flight Center will continue to be the nation's leader in technology and scientific research from space. I ask each of you to become involved as the opportunity arises.

COMMUNICATION HINTS ON THE WAY

A new column designed to help Goddard employees improve writing and communications skills begins in the April issue of the Goddard News. The column will provide tips on how to give effective speeches and presentations, improving letter and memo writing and writing for various types of publications. Don't miss the debut of this column in the next issue of the Goddard News.

X-ray Timing Explorer renamed by NASA

NASA has renamed the X-ray Timing Explorer, placed into orbit in December 1995, in honor of a pioneer in the field of X-ray astronomy, Bruno B. Rossi. The new official title of the 6,700-pound observatory is the Bruno B. Rossi X-ray Timing Explorer (RXTE).

The RXTE is currently in a circular 360-statute-mile (580-kilometer) orbit with an inclination of 23 degrees. Among the objects to be studied by RXTE are stellar black holes, neutron stars and quasars.

Professor Rossi and his colleagues discovered the first non-solar source of X-rays in a dramatic rocket flight in 1962. This source, Scorpius X-1, was the first of many collapsed stars that also are a key topic of study for the RXTE.

Rossi, who died in 1993 after a long and distinguished career, served as professor of Physics and Professor Emeritus at the Massachusetts Institute of Technology. He can be described as a pioneer in two separate fields of observational space astrophysics: X-ray astronomy and space plasma physics. He was the co-recipient of the prestigious Wolf Prize in Physics in 1987. The Bruno Rossi Prize, awarded annually by the American Astronomical Society to a top astrophysicist for achievements in the field, is named in his honor.

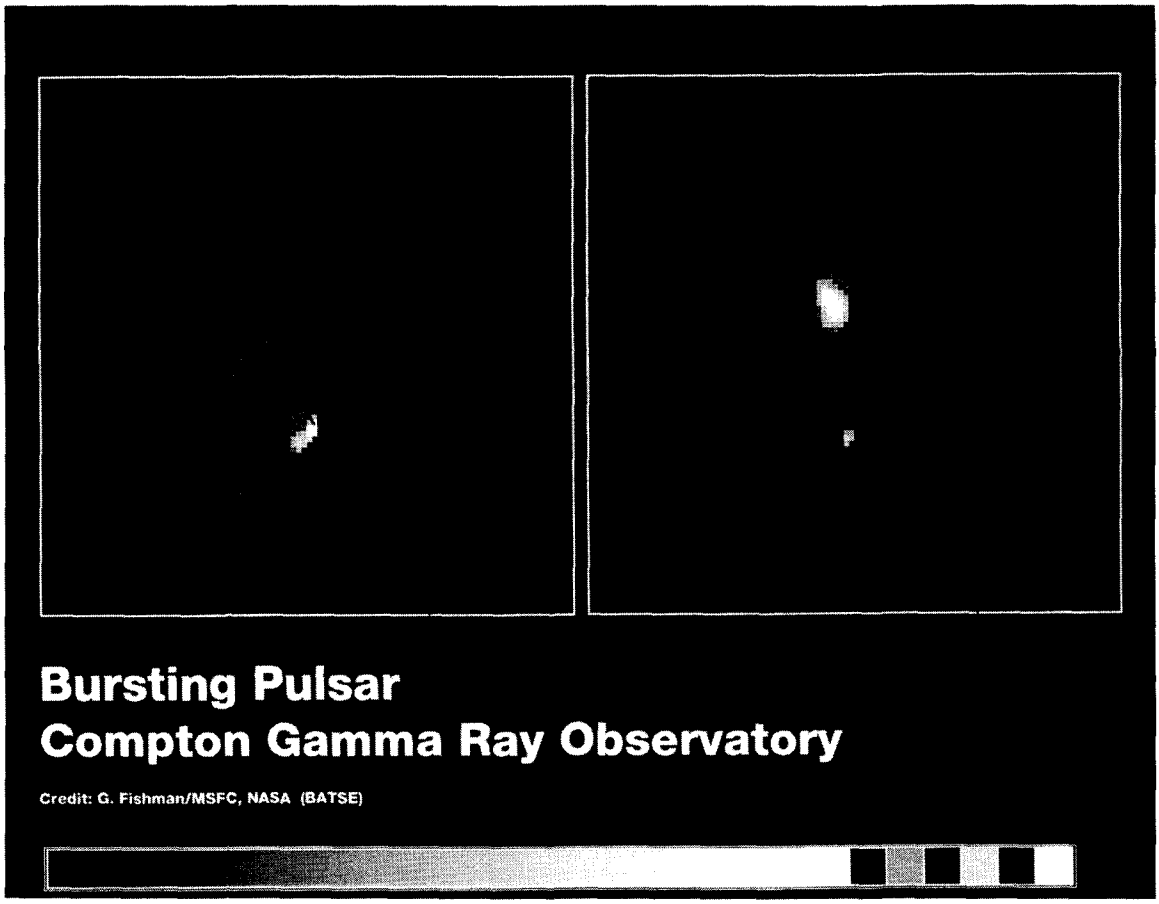
The spacecraft, which is about the size of a telephone booth, is carrying three science instruments which work together to increase scientific understanding of cosmic X-rays sources.

RXTE is the first mission for which 100 percent of the observing time will be available to the broad scientific community. Specific observations will be proposed by scientists from the United States and abroad. Observations are planned by scientists at the XTE Science Operations Center at Goddard.

The RXTE was developed by and is managed and operated by Goddard for NASA's Office of Space Science, Washington, D.C.

New type of astronomical object discovered in our galaxy

by Donna Drelick



NASA astronomers have discovered a new type of object towards the center of our Milky Way galaxy exhibiting a combination of behaviors never before seen in the 35-year history of gamma-ray astronomy.

During the first day it was observed, the source produced over 140 powerful bursts of gamma-rays; since then, it has settled down to a daily rate of about 20 bursts. It is currently the brightest source of hard X-ray/gamma-rays in the sky.

The discovery was announced recently in a paper published in the scientific journal "Nature" by scientists from the Marshall Space Flight Center; the University of Alabama in Huntsville; the Massachusetts Institute of Technology in Cambridge, Mass.; and the University of Amsterdam in the Netherlands.

The unusual object in the southern sky was discovered in early December 1995 by researchers using an instrument known as the Burst and Transient Source Experiment, aboard the Goddard-managed Compton Gamma Ray Observatory spacecraft. Since Dec. 2, the new burster has produced more than 1,000 hard X-ray bursts.

"We're particularly excited about the discovery of a new X-ray source," said NASA Marshall astrophysicist Dr. Gerald Fishman. "The object's strange behavior is one of the major discoveries in X-ray astronomy in the past decade."

In mid-December, NASA scientists discovered an additional source of steady radiation that seemed to reside at the same position in the sky with the burster. This new object further surprised scientists when it was observed to continuously emit pulses at a rate of about twice per second. It was now classified as a pulsar, and scientists soon learned the burster and the pulsar were one and the same source.

"The properties of this X-ray source are unlike those of any we know," explained Dr. Chryssa Kouveliotou of Marshall. "The burst repetition rate makes this phenomenon very different from gamma ray bursts that we have observed several thousand times from throughout the universe. Also, the longer duration and persistent bursting makes the object very different from so-called Soft Gamma Ray Repeaters, which have been observed to burst in short, isolated episodes separated by several years."

This bursting pulsar was later found by Dr. Mark Finger of the Universities Space Research Association at Marshall to be a member of a binary system, performing one full revolution around its low-mass companion every 12 days. "The most likely explanation at this time is that the bursts of X-ray energy may result when the lighter of the pair of stars loses its material by gravitational or magnetic forces to the neutron star," said Kouveliotou.

A neutron star is an exotic star with a mass greater than the Sun and a diameter of only about 10 miles. "The discovery of the new X-ray source may lead to a better understanding of how neutron stars form and evolve," Kouveliotou said.

The source was discovered shortly before the recent launch of the Goddard-managed Rossi X-ray Timing Explorer (RXTE) spacecraft, (recently renamed see story on page 2) which carries the largest collecting area of X-ray detectors ever flown in space. "Our highest scientific priority, after evaluating the operation of the satellite and X-ray instruments, was observing this transient source" said Frank Marshall, Director of RXTE's Science Operations Center at Goddard.

"With better measurements, we should be able to pin down the heoretical model," says Dr. Jean Swank, RXTE Project Scientist at Goddard. As soon as RXTE could observe the source, its detectors were pointed to

See ASTRONOMICAL on page 5

Hubble reveals Pluto's surface

by Tammy Jones

For the first time since Pluto's discovery 66 years ago, astronomers have at last directly seen details on the surface of the solar system's farthest known planet from pictures sent back by the European Space Agency's Faint Object Camera aboard NASA's Hubble Space Telescope.

Hubble's snapshots of nearly the entire surface of Pluto, taken as the planet rotated through a 6.4-day period, show that Pluto is a complex object, with more large-scale contrast than any planet, except Earth.

The images also reveal almost a dozen distinctive albedo features, or provinces, none of which have ever been seen before. They include a "ragged" northern polar cap bisected by a dark strip, a bright spot seen rotating with the planet, a cluster of dark spots, and a bright linear marking that is intriguing the scientific team analyzing the images. The images confirm the presence of icy-bright polar cap features, which had been inferred from indirect evidence for surface markings in the 1980s.

This historic new look at Pluto helps pave the way for a proposed Pluto flyby mission early in the next century. Pluto is the only solar system planet not yet visited by a spacecraft.

"Hubble is providing the first, tantalizing glimpse of what Pluto will be like when we get there," said Dr. Alan Stern of Southwest Research Institute's Boulder, Colo., research office. Stern led the team who used Hubble to obtain the most detailed view yet of Pluto. The Pluto imaging team also includes Dr. Marc Buie of Lowell Observatory, Flagstaff, Ariz., and Dr. Laurence Trafton of the University of Texas, Austin. This team of planetary scientists used the Faint Object Camera aboard the Hubble to obtain more than a dozen high-quality visible and ultraviolet images of Pluto in mid-1994. Those images have now been carefully reduced and analyzed.

The Hubble images reveal much more surface variety on Pluto than on other icy objects in the outer solar system, including Pluto's often-cited twin, Neptune's large moon Triton.

Pluto is two-thirds the size of Earth's Moon, and 1,200 times farther away. Pluto's apparent size in the sky is so small (0.1 arcseconds, which equals 1/36,000th of a degree), that 18,000 Plutos would need to be lined up to match the diameter of the full Moon. This puts Pluto's surface below the resolution limit of the largest ground-based telescopes; as a result it has been impossible to directly see any significant detail on Pluto before these Hubble observations.

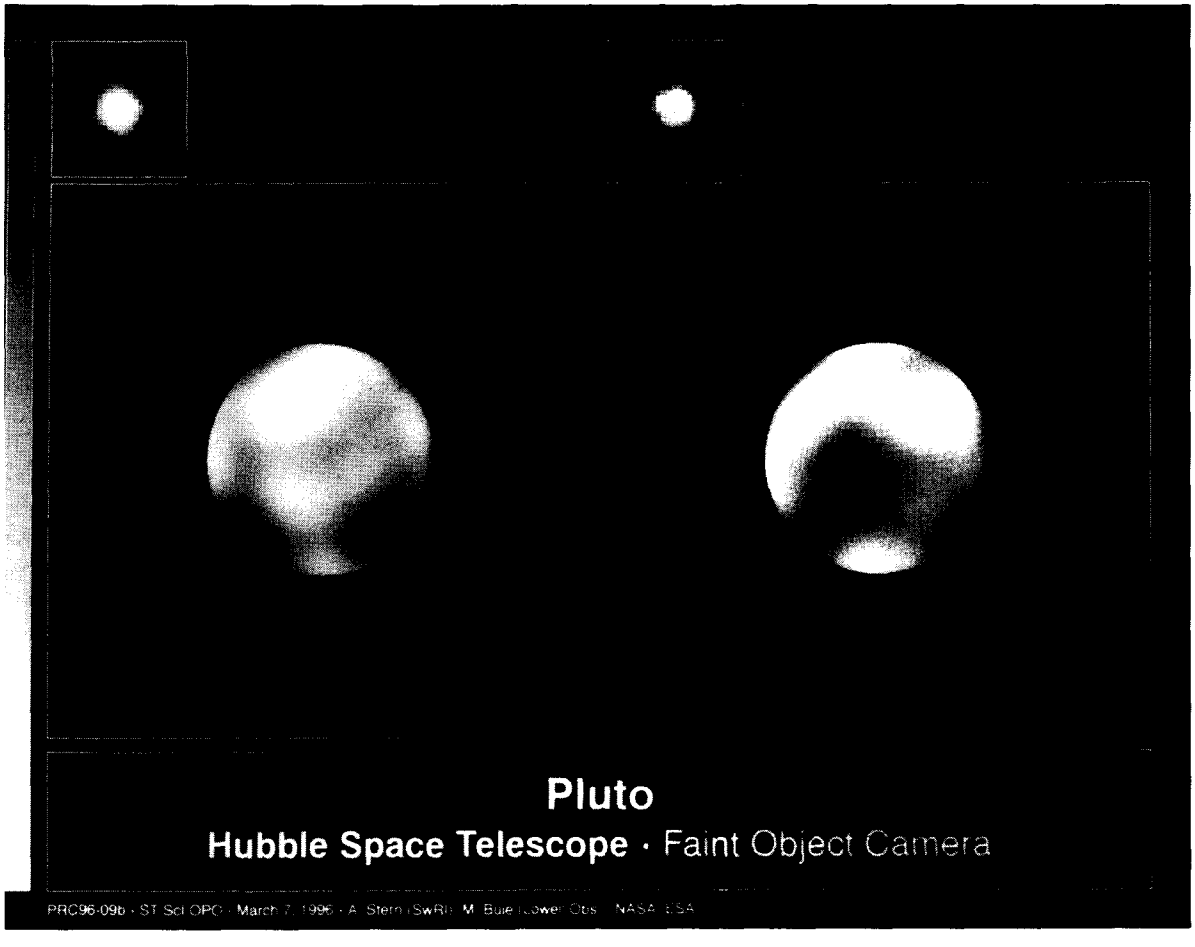
Viewing such a remote and small body has been so difficult that Pluto's moon Charon was not detected until 1978, despite the fact that Pluto itself was discovered by Clyde Tombaugh in 1930.

Shortly after its launch in 1990, the Hubble Space Telescope first peered at Pluto and clearly distinguished the planet and its satellite (which is only 1/3000th of a degree away) as two separate objects. However, a detailed look at Pluto's surface had to wait until Hubble's optics were improved during the 1993 servicing mission.

The Advanced Camera, planned to be installed on Hubble in 1999, will yield slightly better images of Pluto. This will be the best view of the distant planet until space probes eventually make the long trek across the solar system.

The Space Telescope Science Institute is operated by the Association of Universities for Research in Astronomy, Inc., for NASA, under contract with Goddard. The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency.

NASA/ESA



Polar in an elliptical orbit

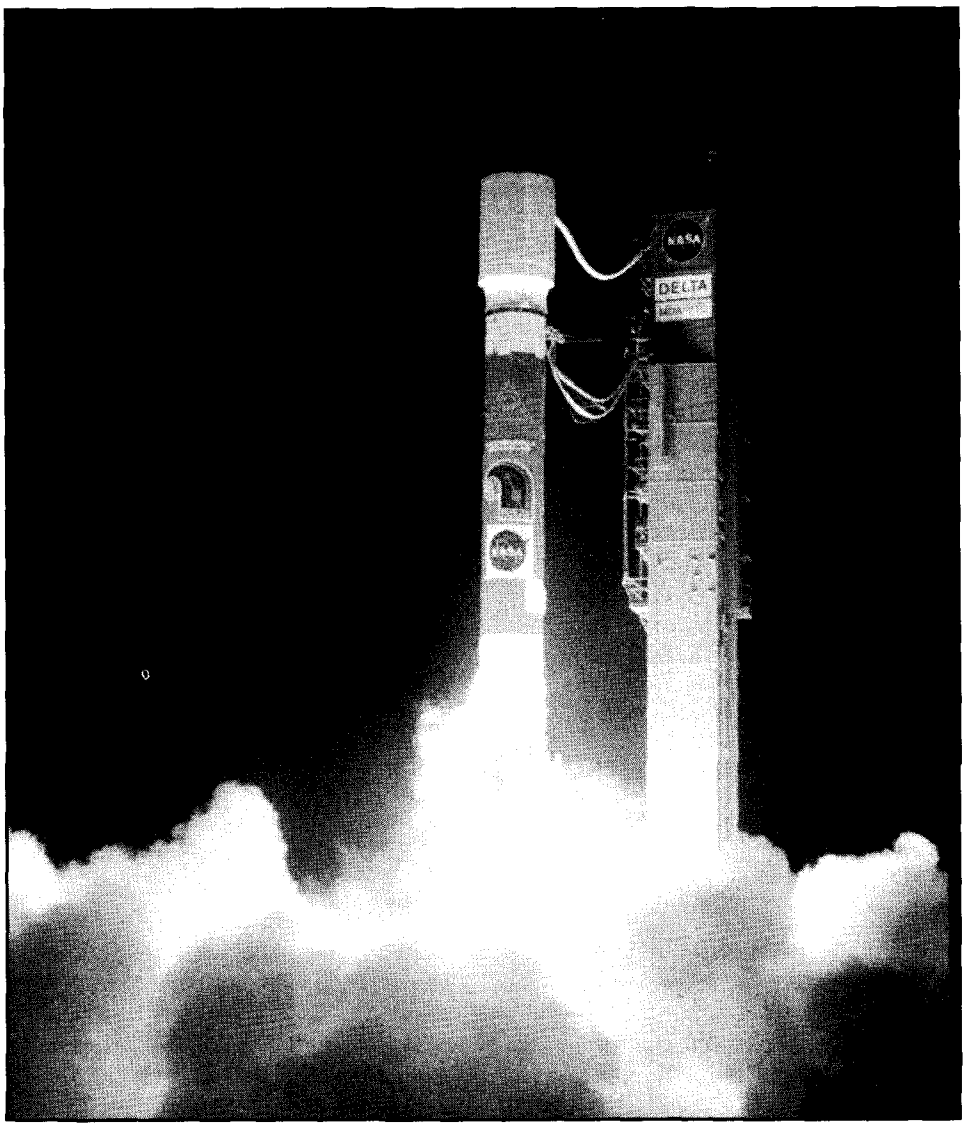
Continued from page 1

the despun platform. Dry weight is 2,200 pounds, with an additional 660 pounds of hydrazine propellant for orbit and attitude control. Its design life is three years.

The instruments on the Polar spacecraft were supplied by university and industry teams as well as NASA laboratories. Data from the instruments will be used to study a vast range of phenomena from electromagnetic radiation to charged particles from very low to relativistic energies. Especially important on Polar are the three high resolution imagers looking down on the Earth's polar region. The instruments will image at wavelengths from the visible to ultraviolet and into the X-ray region.

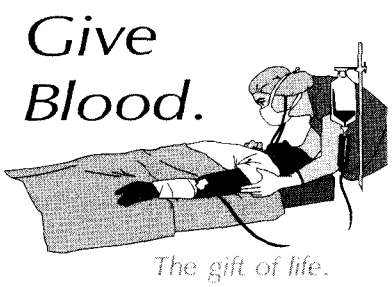
Goddard manages the Polar project for the Office of Space Sciences at NASA Headquarters.

Information about the Polar mission and the ISTP are available on the Internet at the following locations: Polar:http://www.istp.gsfc.nasa.gov/ISTP/ggs_project.html;ISTP:http://www.istp.gsfc.nasa.gov/



NASA

A Delta II rocket managed by Goddard's Orbital Launch Services Project (Code 470) lifts off from Space Launch Complex-2 at Vandenberg AFB.



New astronomical object discovered

ASTRONOMICAL, from page 3

obtain detailed information about the X-ray spectrum and its variations.

The two large instruments on the spacecraft, provided by teams led by Swank and Dr. Richard Rothschild of the University of California at San Diego, quickly found the source to be very bright across the X-ray band from 2 to 60 keV, with strong persistent emission as well as numerous bursts.

RXTE made repeated scans across the source to determine the position of the source accurately enough to allow astronomers to search for radio or visible light from it. Within the past ten days, a radio source and a very faint visible star have been identified in the direction of the X-ray source. Scientists are working furiously to see if the radio and visible light are coming from this object.

The bursting pulsar is a transient X-ray star that is expected to die out fairly soon, within a few weeks to, at most, a few months. Therefore, scientists are working feverishly to try to unravel its mysteries while it still shines.

The Compton Gamma Ray Observatory, launched in 1991, is managed by Goddard. The Burst and Transient Source Experiment is managed by Marshall Space Flight Center. The Rossi X-Ray Timing Explorer, launched on Dec. 30, 1995, is also managed by Goddard Orbital Launch Services (Code 470) team.

Goddard engineer may become astronaut

by Ann Jenkins

NASA

To prepare for the Hubble Space Telescope Second Servicing Mission, Paul Richards works underwater during tests that simulate the astronauts' tasks in space.

Many children dream of becoming astronauts, but Paul Richards, of the Hubble Space Telescope Project, never gave up that dream. A Goddard engineer who regularly works with astronauts, Richards, 31, recently completed a battery of medical and psychological tests and interviews at the Johnson Space Center to see if he has got the "right stuff" to become an astronaut.

"I remember watching the Apollo launches in kindergarten ...the teacher sitting us down in front of the TV," says Richards. "Ever since then I wanted to be an astronaut."

Richards just finished the next-to-last step in achieving his dream: a week-long series of extensive tests and a personal interview with NASA's astronaut selection committee. He was one of 123 chosen from a field of about 2,500 applicants. NASA will chose about 20 to become astronauts. Their names will be released in mid-April.

Since joining the Goddard team, Richards has worked on many exciting projects, the most recent being the Hubble Space Telescope Flight Systems and Servicing Project. Richards developed tools used by the astronauts to service Hubble in 1993. That mission improved Hubble's vision and helped change modern astronomy.

"The first (Hubble servicing) mission involved redesigning some power tools and coming up with some other tools from scratch," explains Richards.

On Hubble's Second Servicing Mission, scheduled for 1997, astronauts will place two new instruments on Hubble and do scheduled maintenance. For this mission, Richards explains "I'm the team lead on the next generation power tool, which is the Pistol Grip Tool. That's what I focus most of my attention and energy on."

Richards also serves as a "suited test subject," which means he gets to play astronaut during underwater tests that simulate space conditions. "One of the best ways to simulate it (the astronauts' work in space) is to run neutral buoyancy simulations. So we actually get in a space suit that is tied to umbilicals and go underwater in a tank 40 feet high, 80 feet across.

"We have a mockup of the Hubble in it (the tank) and a mockup of the Shuttle. With the assistance of scuba divers and a whole team, we work through the missions. ...I become sort of a liaison between the design engineers and the astronauts."

One of Richards' favorite tools is the Pistol Grip Tool, which he developed for the Hubble Second Servicing Mission. The tool was recently selected to aid in the building of Space Station. The Pistol Grip Tool has many features found in high-end, industrial power tools, but it is much smaller and self-contained. Though developed for NASA, Richards foresees its use in medicine, particularly in orthopedics.

Richards' work has earned him numerous NASA awards, including the astronauts' own Silver Snoopy. Given for enhancing flight safety and mission success, the coveted Silver Snoopy award was presented to Richards by astronaut Jeff Hoffman of the first Hubble servicing mission.

"The Silver Snoopy is the most relevant award I have because it's given directly by the crew, who is the end user," says Richards. "The other accomplishment I'm proud of is that the tools performed well during the mission, and seeing Hubble accomplish its mission and its objectives after the servicing mission. That was more satisfying than any individual award — to be a part, to do good engineering, and then to see it be able to bring down great science."

Another one of his proudest moments was having his tools demonstrated on the top-rated TV show *Home Improvement*—by the astronauts of the Hubble servicing mission! "The crew from the Hubble Servicing Mission was invited to be on the show *Home Improvement*, on the 'Tool Time' segment of it," says Richards. "I got to sit in the audience and see the taping of it. And before the show, I got to have dinner with Tim Allen and Debbie Dunning, who plays Heidi on the show. Then, after the show, I also got to go on-stage and get my picture taken with the (Hubble First Servicing Mission) crew and Tim and Al."

When asked if he would like to service the Hubble Space Telescope himself on the scheduled 1999 servicing mission, Richards responds, "I'd love to! That would be an excellent mission to come back on. And to work again with the people here at Goddard would be great, and to work with Hubble, which I am so familiar with after spending the last five years of my life on Hubble."

Beyond his goal of becoming a mission specialist astronaut, Richards says "I'd also eventually like to get into teaching and to eventually finish my studies and get my doctorate. I'd like to teach at the college level, teaching hands-on engineering—the kind of work we do at Goddard."

Smithsonian features Goddard observatory

Photo by Marc DeBord

The Compton Gamma Ray Observatory, a mini-exhibition on the scientific goals and achievements of the Goddard-managed Compton Gamma Ray Observatory spacecraft, opened at the National Air and Space Museum in Washington, D.C. last month. Launched from the Space Shuttle Atlantis in 1991, the Compton Observatory is the second of NASA's Great Observatories, a family of four orbiting telescopes designed to study the universe in both visible and non-visible forms of light. The first, the Hubble Space Telescope, was launched in 1990. The mini-exhibition is located in the Museum's Milestone of Flight gallery and will be open to the public through October 1996.

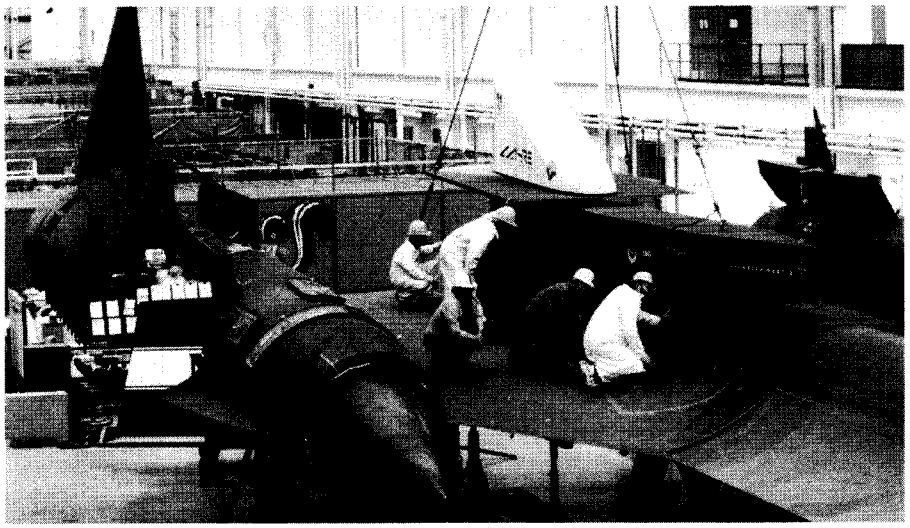
Retirees

Congratulations to the following employees who recently retired!

Name	Code	Years
Michael Rice	532.1	38
Llewellyn Nicholson	410	35
Gerald Taylor	754.2	33
Roger Jenkin	110	30
Reed McDowell	228	30
William Schoene	515.2	30
William Withgott	514.2	28
Kathleen Williams	114	27
Marjorie Johns	722.3	26
George Tompkins	224.2	22

Development of next generation Shuttle underway

Photo by Denny Lombard



Team members on the Linear Aerospike SR-71 Experiment (LASRE) perform fit checks on a 10 percent scale, half-span model of Lockheed Martin's Single-Stage-To-Orbit (SSTO) Reusable Launch Vehicle (RLV) as it is about to be mated to an SR-71 Blackbird in Palmdale, Calif. The test engine and its mount containing hydrogen fuel, water, helium and control computers weighs 13,800 pounds. The mount is 41 feet in length.

The SSTO RLV is being developed to replace the NASA Space Shuttle fleet in the next century. An advanced technology demonstrator vehicle, the X-33, will be built and flight tested in 1999.

The industry/government LASRE team, led by Lockheed Martin Skunk Works, includes Lockheed Martin Astronautics, Rocketdyne, Dryden Flight Research Center, Marshall Space Flight Center, and USAF Phillips Laboratory, Propulsion Directorate.

Local students to make observations using Hubble Space Telescope

by Tammy Jones

Students in grades K-12, working alongside some of America's foremost astronomers, will have a chance this spring to help do real science observations using NASA's Hubble Space Telescope. The resulting observations will be featured in a live, interactive telecast on NASA TV and public television this month and in April.

The observing time was offered to students by astronomers from a lively discussion and debate via the Internet. Students were challenged to go on-line to do research and decide which planet in the solar system would be best to study. Neptune and Pluto were selected as targets by students who will be serving as Hubble Space Telescope "Co-Investigators".

Over the next two months, mission planners will transform the students' selection into detailed plans for the observations. Students will be able to follow the progress of their upcoming observations via the Internet. The students then will be featured on "Live from the Hubble Space Telescope: Making Your Observations" which aired March 14, and again on "Live from the Hubble Space Telescope: Announcing Your Results" airing at 1 p.m. EST, April 23.

"Live from the Hubble Space Telescope" is part of the ongoing Passport To Knowledge series. The series provides low- or no-cost access to "real science, real scientists, real locations, real-time" by using integrated multimedia components — print, on-line and live video.

Passport To Knowledge is supported by NASA, the Space Telescope Science Institute, the National Science Foundation and public television. For more information, access the project's home page on the World Wide Web at: http://quest.arc. nasa.gov/live from/hst.html or send e-mail to: listmanager @quest.arc.nasa.gov and in the message body write: subscribe updates-hst.

An information hotline is available on 1-800-626-LIVE (626-5483) or (908) 273-4108.

JASON Project on tap for April

The annual Jason Project broadcasts are scheduled to begin in April. They have been designed to motivate students' interest in science and geography for grades 4 through 9 and to increase their awareness of career opportunities in the sciences. Through telepresence, live telecasts via satellite, students have the opportunity to join teams of scientists as they carry out a wide range of environmental research projects in Florida.

Goddard participates as a Primary Interactive Network Site (PINS) for the JASON Project Voyage VII: Adapting to a Changing Sea. All of the JASON broadcasts will be shown in the GSFC Visitor Center Auditorium which has a total seating capacity of 100 people. The Educational Programs Team is taking reservations from Goddard employees and their families for:

Wednesday, April 17, at 2:30 p.m.
Friday, April 19, at 4 p.m.
Saturday, April 20, at 1 p.m.
Wednesday, April 24, at 2:30 p.m.
Thursday, April 25, at 4 p.m.

The deadline to phone in reservations is March 29, and can be made by calling either Diane Cockrell or Michelle Jackson at 6-7205.

After securing reservations plan on arriving at least fifteen minutes prior to the broadcast time. Each one hour JASON broadcast session will be followed by a ten-minute question and answer period.

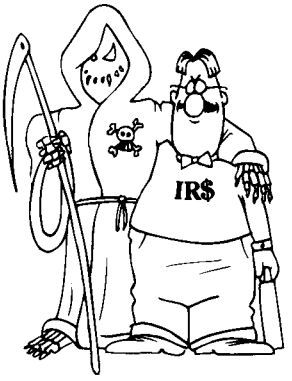
Goddard News NASA

National Aeronautics and Space Administration — Goddard Space Flight Center

The GODDARD NEWS is published monthly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

Deadline to submit material is the first of each month. For additional information contact Fred Brown (301) 286-8955.

The GODDARD NEWS Staff is:
Executive Editor: Jim Sahli
Managing Editor: Fred Brown
Contributing Editors: Donna Drelick, Tammy Jones, W. Allen Kenitzer, Ernie J. Shannon



COMING IN APRIL!

National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

April 1996 Vol. 43 No. 14

INSIDE

2 Director's Update

4 NASA Observes Comet Hyakutake

5 ROSAT Image of Comet

6 Invention of the Year

8 Outreach Defined

Goddard leadership shares vision of Center's future

"The American people are calling for dramatic changes in the way their Government works. They want a smaller, less expensive Government that delivers more for less—one that does the right things, with the right people, at the right cost. NASA is in the vanguard of Government reinvention. We are revolutionizing the Agency, and the NASA that emerges will be better than ever. Responding to the needs of the American people and other Government agencies, we are returning NASA to a research and development Agency with a renewed focus on the development and application of new cutting-edge technologies, giving up-front consideration to the potential commercial use of our technologies," so writes NASA Administrator Daniel Goldin in the 1996 NASA Strategic Plan.

On April 8 in Goddard's Building 3 Auditorium, Center Director Joseph Rothenberg, Deputy Center Director Al Diaz and Dr. Dorothy Zukor, leader of Goddard's Strategic Planning Team, addressed the Agency's Strategic Plan and spoke to employees about the Center's future. A future they say will be filled with the challenge of change.

The Agency is changing and that change impacts Goddard. Rothenberg and senior Center management told employees that the Center is responding to the challenges of the changing environment in the NASA Strategic Plan.

NASA is learning to do more with a smaller budget and a shrinking workforce. In his March 19, 1996, Agency-wide budget report Mr. Goldin said, "There is a new attitude out at NASA/Goddard. I think Joe Rothenberg and Al Diaz are to be commended. They are committed to getting costs cut and this is important."

To carry out this responsibility, Goddard needs to develop itself as a national resource that in collaboration with academia and industry carries out its mission in the future in more innovative ways. GSFC needs to refocus the workforce to a more hands-on technical organization. Goddard must increase partnerships with industry by looking for technology commercialization opportunities and increase our inreach and outreach activities to ensure a wide community involvement and benefit from NASA/Goddard programs.

GSFC 2005

According to Diaz, all Center planning efforts will consider that the future does not hold the promise of necessary resources to provide the scientific community with the kind of product Goddard has provided in the past. This means changes in the way GSFC works to get things accomplished.

"We have an opportunity at Goddard to re-engage our dreams. The challenge is that we have is to do it in the context of a new budget reality. We have an opportunity to transform our flight program activity into a program that is consistent with the budget through investments in technology and through new ways of doing business," Diaz said.

The challenge for Goddard is to find new and innovative ways to do more science, technology, and research and development, as well as less routine operations while establishing initiatives that enable lower costs and technology advances.

Senior management has accepted the challenge and is by example exploring ways to reduce the cost of the Mission to Planet Earth missions by introducing new technology as early as the CHEM 1 mission and to follow that up with the incorporation of lessons learned from the first series of Earth Observing System (EOS) missions. Diaz says "Reducing the cost of the overall run-out allows us to achieve what the Administrator has committed to, which is the full capture of the 24 measurements that are defined for the EOS program."

Strategic Planning Activities

The Center's Strategic Plan is being developed by a team led by Dr. Zukor. According to Zukor, the plan will help GSFC get its bearing in these times of change. "Our hope is to have a plan that we can use. It may not even be a document. It may just come out on the internet and may just be a series of bullets. Hopefully it will be something that you can look at, refer to and use for guidance in making decisions for an extremely successful future."

The new approach to planning is proactive and flexible. The goal is to have the plan drive the Center resource allocations, and not the other way around. "We want to be proactive and come up with a plan that says this is what we want to do, and work to get the resources to carry out the plan. We must have alternatives in place so that we can do a portion of the plan, or have different ways of doing it so that we achieve our strategic goals." Zukor said.

The Strategic Plan also will provide the framework with its programmatic and technology goals, to re-engineer the Center processes and organization. The re-engineering process is expected to get underway in the next several months.

Goddard's Vision

Goddard's future vision includes a new way of doing business with increased collaborative efforts with academia and industry while working within the con-

Continued on page 8

Director's Update

by Joe Rothenberg

By now you are aware that it is again the season when the NASA budget is under scrutiny. As Administrator Dan Goldin and various Associate Administrators defend NASA's budget to Congress, they are continually asked not only to revalidate NASA's programs but also the very relevance of our agency. I believe Goddards' mission is both relevant to the nation and critical to increasing the knowledge of Earth systems and the universe.

Our NOAA and GOES spacecraft are important tools for forecasting and tracking global weather. These spacecraft provide a vital resource that enable the tracking of severe weather activity that saves lives and property. Our Mission to Planet Earth program will provide the data which will enable humans to preserve the Earth's environment for future generations, and, in the final analysis, help preserve the planet.

We all feel the excitement of new discoveries that are generated from our ongoing space science investigations into the mysteries of the universe.

At Goddard, we have leadership roles in answering several questions that are motivating the Agency's space science community. Through education and outreach we are communicating this excitement to the youth of our nation.

I believe that Goddard's leadership in answering these questions will continue to motivate youth to enter the technical and scientific career fields, enabling the U.S. to maintain our technological leadership.

If the relevance of NASA or the importance of your contribution to the Goddard mission ever comes into question just ask yourself will the nation and planet survive without NASA?

Communication Tips

LETTERS & MEMOS

No way they can be avoided. Written communications-up, down, and across -are woven into the fabric of American enterprise. These helpful hints can make your letters and memos more effective.

A conversational tone is best

Whether you're writing to subordinates, peers, or higher-ups, a conversational tone will draw people to your point of view. For example:

Formal: I would suggest that you remit the balance in full within 10 days of receipt of this notice. Conversational: Please send us a check for the balance of the payment by March 15.

Formal: Please be advised that we are processing your claims for monthly benefits. Conversational: We're processing your claims for monthly benefits.

By writing this way, you'll be seen as a person, not a bureaucrat who doesn't understand the lives of others.

Advertising techniques bring success to memos

Don't be afraid to use the techniques of advertising in your communications. Even the most routine memos can benefit:

• When referencing a Goddard organization, refer to it by name rather than by code. This will lend personality to the organization and remind us that our center is made up of people, not organization charts. Of course, when referring to a center mailing address, it is acceptable to use the organization code.

• Break up the size of type blocks. For instance, move in the margins of a particularly important paragraph two or more inches on both sides.

• Use boldfaced, action-oriented headlines and subheads.

• Underline key phrases.

• Use bulleted lists rather than lines of narrative.

• Be aggressive in your use of white space. For instance, a memo of one or two paragraphs typically occupies the top few lines of the page. If you center those lines in the middle of the page, and surround it dramatically by white space, you will draw your readers into the story.

Avoid ending letters with clichés

Do you end your letters with a formulaic tag line that is devoid of meaning?

• A typical ending: "Please feel free to contact me if you have any questions." Instead, end letters by spelling out the next steps you expect.

• Your closing lines could be: I will look for your response in the next few days, I will be glad to answer any questions, and I will call you to discuss further.

Be concise when writing

Wordy writing is weak writing. To write more powerfully, follow these rules:

1. Remove unnecessary modifiers. We absolutely guarantee all our products. Her contribution was very crucial to our success.

2. Don't identify places, books, or objects that are self-evident. *Not:* He is from the city of Houston. But: He is from Houston.

3. Avoid beginning your sentences with empty words such as "frankly", "essentially", and "basically".

4. Whenever possible, remove phrases such as "at the rate of" and "in the time of". *Not:* He types at the rate of 55 words per minute. But: He types 55 words per minute.

5. Avoid the expression "serve as a". Rephrase the sentence or try substituting is or are. *Not:* She serves as our proofreader. But: She is our proofreader.

6. Avoid the phrase "the reason is because". You can often trim it down by rewording the sentence. *Not:* The reason he finishes early is because he is organized. But: He finishes early because he is organized.

(*Style, Darn Ya, Style,* F&W Publications, and cited in Writer's Digest, 1507 Dana Ave., Cincinnati, OH 45207)

Compton Gamma Ray Observatory on orbit five years

by Donna Drelick

The Goddard-managed Compton Gamma Ray Observatory marked its fifth year on orbit April 5. Launched in 1991 from the Space Shuttle Atlantis, the Compton observatory is the second in a series of Great Observatories and is the heaviest spacecraft ever deployed by a shuttle.

The Compton Observatory, named for American Nobel Prize-winning physicist Arthur Holly Compton, is the first satellite dedicated to making gamma ray observations across a broad spectrum of energies. Scientists believe that gamma rays, which are an invisible, highly energetic form of radiation, are emitted during violent cosmic events such as supernovae, quasars, pulsars and black holes.

NASA scientists used CGRO to create a comprehensive map of celestial gamma ray sources. "The spacecraft and instruments have been remarkably reliable, and all four instruments are performing near their design specification" said Dr. Neil Gehrels, CGRO Project Manager at Goddard. "Thus far CGRO has made extraordinary discoveries, and the science team is looking forward to more discoveries as the observatory begins its sixth year in space."

Although tape recorders on the observatory failed early in the mission, that turned out to be an unexpected scientific bonus. Instead of storing data on the spacecraft and retrieving it every four hours, scientists can now receive a 24-hour-a-day stream of data in real time. This allows scientists to quickly begin monitoring outbursts of energy, such as on Jan. 31, 1993, when the satellite detected the highest energy gamma rays ever seen in a burst, an event dubbed the "Super Bowl Burst." In December 1995, CGRO detected the sudden appearance of a never-before-seen type of object which bursts and pulses at the same time. This bursting pulsar is currently the brightest source of gamma rays and X-rays in the sky.

Among CGRO's most significant discoveries:

- The discovery that gamma ray bursts are evenly distributed across the sky, which suggests that gamma rays are coming from farthest reaches of space and not just from our own Milky Way galaxy, as astronomers once believed.
- The discovery of gamma ray quasars, a new class of high-energy gamma ray sources, in Active Galactic Nuclei (AGN), the bright and active central cores of some galaxies.
- The discovery in December 1995 of a source of gamma rays and X-rays that exhibits the behavior of both a pulsar and a burster. During the first day it was observed, it produced more than 140 powerful bursts of gamma rays. It is currently the brightest source of gamma rays and X-rays in the sky.
- The discovery that gamma ray bursts and solar flares are accompanied not only by a release of low-energy gamma rays over a relatively short period of time (tenths of seconds to seconds) but also by a release of high energy gamma rays over a longer period of time.
- The discovery that a second class of gamma-ray emitting AGN, known as Seyfert galaxies, emit most of their gamma-rays at lower energies than previously thought. This is important evidence that such objects may be the source of diffuse gamma rays.
- A threefold increase, from two to six, in the number of pulsars known to emit gamma rays (pulsars are rotating neutron stars that spin very rapidly and produce beams of radio energy that appear to flash on and off), among more than 500 known radio pulsars. This gives astronomers a greater opportunity to understand why some pulsars emit gamma rays and others do not.
- The first detection of the presence and nuclear decay of cobalt 57, an isotope of cobalt thought to have been created during the explosion of a star known as Supernova 1987A. This detection helps confirm the nucleosynthesis theory of how elements heavier than hydrogen and helium are formed and distributed in our galaxy via the evolution of stars.
- The discovery that the energy (photons of light) created by the mutual destruction of electrons and positrons ("anti particles") in our galaxy is concentrated in a bulge around the center of the galaxy, with a second component extending out along the plane of our galaxy.
- The first mapping of the distribution of a radioactive isotope called Aluminum 26 within the Milky Way Galaxy. The instruments on CGRO detect the isotope by measuring gamma ray energy associated with its radioactive decay. Scientists believe that this energy distribution, which has proven to be "patchy" rather than smooth, holds clues to understanding nucleosynthesis in our galaxy.
- The detection of the gamma ray energy given off by interactions between cosmic rays and carbon 12 and oxygen 16 nuclei. The energy "signature" associated with the excitation of these molecules and subsequent emission of gamma rays help scientists identify the types of matter and nuclear processes occurring within the region of the Milky Way galaxy known as the Orion Arm.

The Compton observatory currently is in a circular, 240-mile-high orbit inclined 28.5 degrees to the equator. NASA is considering reboosting the 17-ton, low-Earth-orbiting satellite to a higher orbit that would allow the spacecraft to continue to track the gamma ray universe well into the next century.

The Compton Observatory has vastly increased our understanding of some of the most violent events in the universe," said NASA Program Manager Dr. Alan Bunner. "TRW should be congratulated for designing and building such a robust spacecraft which has given us five years of spectacular scientific achievement. We have every reason to believe we will continue to be amazed by its discoveries in the future."

The Compton Observatory is managed for NASA's Office of Space Science, Washington, D.C., by Goddard. CGRO was built by TRW Space & Electronics Group, Redondo Beach, Calif.

Information on the Compton Gamma Ray Observatory is available on the Internet at: http://enemy.gsfc.nasa.gov/cossc/cgro.html

Several NASA spacecraft observe Comet Hyakutake

During March, NASA conducted a variety of activities designed to study the Comet C/1996 B2 Hyakutake and will share this information with the general public.

Discovered on Jan. 30 by Japanese amateur comet hunter Yuji Hyakutake using powerful binoculars, the comet was as bright or brighter than the stars of the Big Dipper. The comet made its closest approach to Earth on March 25 at a distance of about 9.3 million miles. According to the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass, Comet Hyakutake made the nearest passage to Earth of any comet since 1983, and the fifth closest this century.

A comet is a small, icy body that orbits the Sun in an elongated orbit that can be disturbed by the on-going orbits of the planets. Resembling a "dirty snowball," a comet typically has a relatively tiny nucleus, often less than six miles across. When radiation from the sun warms a comet, ice particles from its nucleus tend to "steam" outwards, creating a large coma or surrounding atmosphere and a tail of material that streams away from the Sun. In some cases, the coma and tail can be thousands or even millions of miles across, offering dramatic viewing opportunities. Comet Hyakutake has the potential to provide just such a spectacle.

Goddard-managed spacecraft including the International Ultraviolet Explorer and the Hubble Space Telescope headed NASA's efforts to take images of Comet Hyakutake.

Since Hubble is not actively controlled from the ground and the comet's position was not precisely known, viewing the speeding visitor was especially tricky. Hubble was preprogrammed to point at a selected spot in the sky where the comet was to be at a specific time.

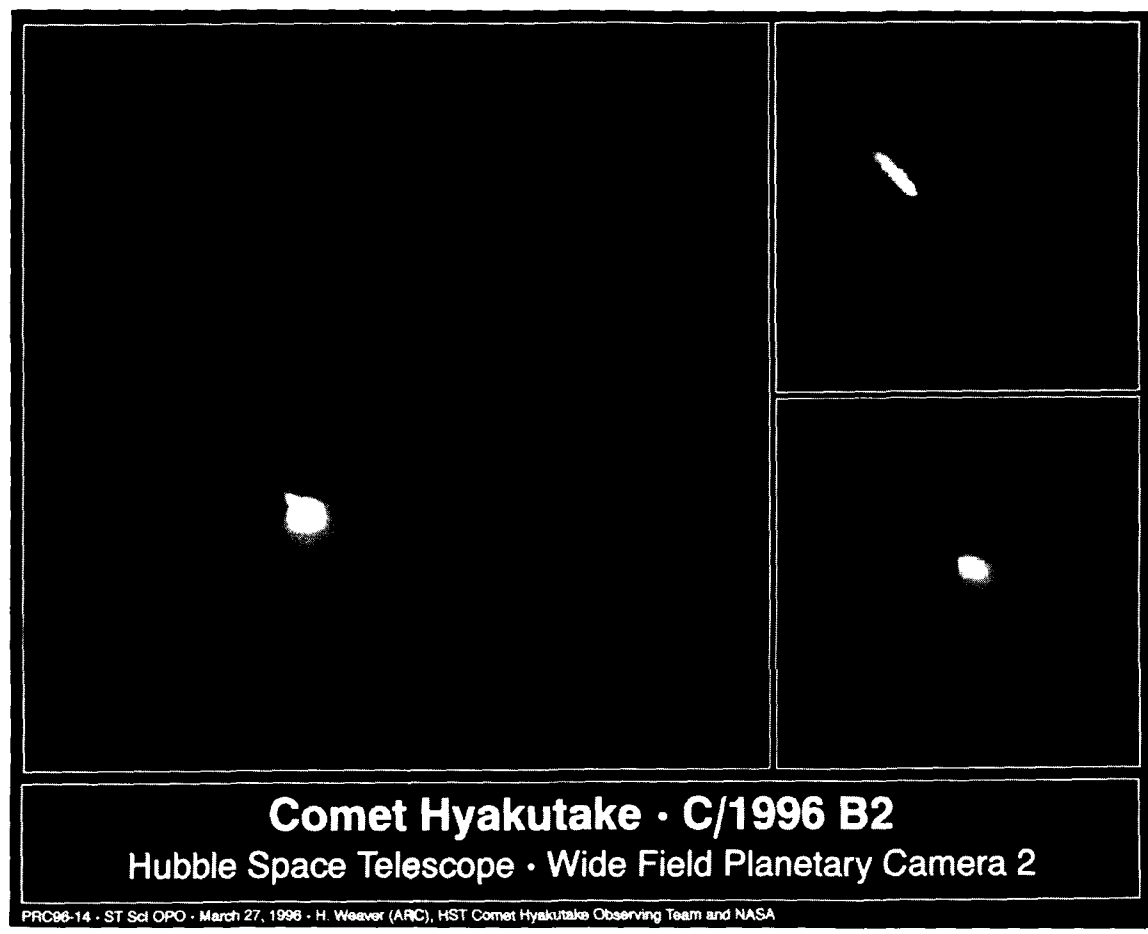
NASA's recently launched Near Earth Asteroid Rendezvous (NEAR) spacecraft took images of the comet as a calibration exercise. Although NEAR offers a different vantage point from Hubble, its camera was not designed to image objects at such large distances.

Several NASA-supported ground-based observatories began studying the comet during late March and will continue in April as the comet approaches perihelion (its closest distance from the Sun.)

NASA's Infrared Telescope Facility (IRTF) on Mauna Kea, Hawaii, also dedicated several days of observing time to study the release of dust and ice grains from the nucleus of the comet. These ices are composed primarily of water. Spectral observations of the molecules vaporized from the nucleus should provide samples of molecular abundances that were present at the time of the formation of the solar system. The Goddard-managed Extreme Ultraviolet Explorer spacecraft made observations of neon and helium for comparison with the water production rates measured by the IRTF.

Images from IRTF and many other sources are posted to a "virtual star party" on the Internet called the "Night of the Comet," sponsored by NASA's Ames Research Center, Mountain View, Calif., NASA's Stratospheric Observatory For Infrared Astronomy program, and its K-12 Internet Initiative. This home page allows anyone with access to a computer and a modem to post and observe Hyakutake images, track the progress of the comet, converse with NASA experts, learn about astronomy and participate in experiments.

"Night of the Comet" can be accessed via the Internet at URL:http://www.comet.arc.nasa.gov/comet/



NASA

These Hubble Space Telescope images of Comet Hyakutake were taken at 8:30 pm. EST on March 25 when the comet passed at a distance of only 9.3 million miles from Earth.

First X-rays from a comet discovered

by Jim Sahli

A team of U.S. and German astrophysicists have made the first ever detection of X-rays coming from a comet.

The discovery of a strong radiation signal — about 100 times brighter than even the most optimistic predictions — was made March 27, 1996, during observations of comet Hyakutake using Germany's orbiting ROSAT satellite.

"It was a thrilling moment when the X-rays from the comet appeared on our screen at the ROSAT ground station," said Dr. Konrad Dennerl of the Max Planck Institute for Extraterrestrial Physics (MPE), Garching, Germany. Following the initial detection, the team reported repeated X-ray emissions from the comet over the next 24 hours. The comet was near its closest approach to the Earth at a distance of less than 10 million miles when it was first detected by ROSAT.

The strength and rapid changes in intensity of the comet's X-ray emission both surprised and puzzled astronomers.

"We had no clear expectation that comets shine in X-rays," said Dr. Michael J. Mumma of Goddard. "Now we have our work cut out for us in explaining these data, but that's the kind of problem you love to have."

The comet was examined repeatedly during March 26-27 as it swept across the sky. In fact the German scientists used a computer to correct for the comet's motion to produce accurate images during each observation. Satellite attitude was not changed during these observations.

X-rays have never been found from a comet before, and scientists had optimistically predicted an intensity that turned out to be about 100 times weaker than the radiation actually detected by ROSAT. Strong changes in the brightness of the X-rays were another surprise. There were pronounced increases and decreases in the X-ray brightness from one ROSAT observation to another, typically over a time difference of a few hours.

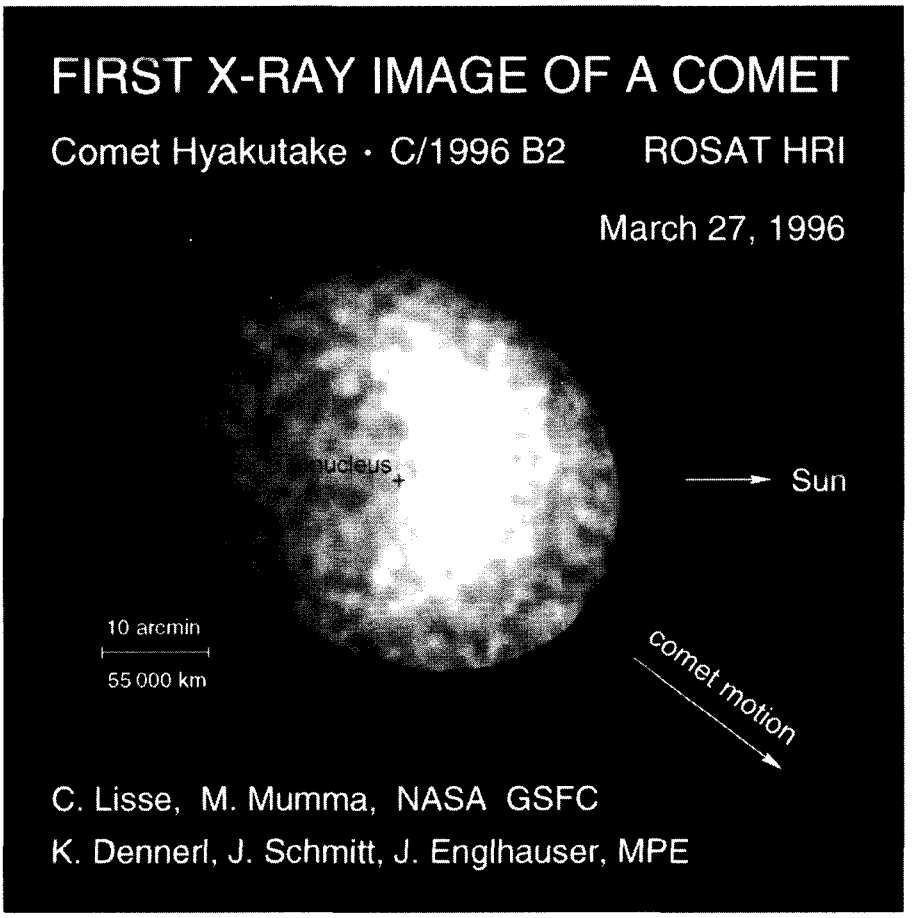
Still another puzzle is the nature of the physical process that generates the X-rays, but the ROSAT image may contain clues to this process. In the image, the X-rays from the comet seem to come from a crescent-shaped region on the sunward side of Comet Hyakutake.

Explaining the unexpected bright X-ray emission is the next major task for the science team. One preliminary theory is that X-ray emission from the Sun was absorbed by a cloud of gaseous water molecules surrounding the nucleus of the comet, and then were re-emitted by the molecules in a process physicists call fluorescence."

According to this idea, the cloud is so thick that its sunward side absorbs nearly all the incoming solar X-rays, so that none reach the remainder of the cloud. This could explain why the cometary X-ray emission has the form of a crescent, rather than that of a sphere around the nucleus.

A second possible explanation is that the X-rays are produced from the violent collision between the comet material and the supersonic "wind" of plasma and particles streaming away from the Sun.

We always learn something new when we study an object at different wavelengths," commented Dr. Carey M. Lisse of Goddard, the leader of the X-ray investigation. "Now we have to determine why the comet is so bright in X-rays, and see what we can learn about its structure and composition from these unique images."



An X-ray image of Comet Hyakutake, as observed by the High Resolution Imager on the ROSAT X-ray observatory. The X-rays arise primarily from a crescent-shaped region with a diameter of about 50,000 km, on the sunlit side of the comet. The directions toward the sun and of the comet motion are indicated by the arrows. No X-ray emission is detected from the nucleus, marked by the "+" sign. The ellipse represents the instrument field of view, not the extent of the X-ray emission.

Goddard development named invention of the year

by Donna Drelick

NASA has selected a technique for encoding and compressing digital data as the winner of the Government Invention of the Year Award for 1995. The "Method for Coding Low Entropy Data," a creation of Dr. Pen-Shu Yeh of Goddard, has been selected by the NASA Office of General Counsel for the honor.

As scientific instruments grow increasingly more precise and sophisticated, the amount of data generated by them also increases. The data compression technology reduces redundancy in the data representation while guaranteeing its full and accurate reconstruction. Using data compression technology on a spacecraft reduces the requirements for onboard memory and ground station contact time, which often translates into saving millions of dollars for a single space mission.

The new coding method also will benefit industry, particularly the medical community. Studies at Goddard indicate the new coding method offers superior performance for medical imaging data systems such as magnetic resonance, ultrasound and nuclear medicine. "The needs of space imaging systems and medical imaging systems are similar in many ways," said Yeh. "Doctors, like scientists, always demand full fidelity of their data.

This encoding method for improving digital data is just one part of the advanced data compression technology developed at Goddard. Several years ago, we realized the need to initiate this technology development because our science community has demanded more and more data from their instruments," Yeh continued. The Method for Coding Low Entropy Data extends performance beyond the bounds set by traditionals codes, making this technology more adaptive to various kinds of instruments and applications.

Implementing data compression on spacecraft requires a technique that adapts easily to changes in data while using little power and memory.

Yeh and her colleagues at Goddard found that the Rice algorithm, developed at the Jet Propulsion Laboratory, Pasadena, Calif., in the early 1970s, adapted to their needs for lossless data compression. Yeh showed that the Rice algorithm was actually a derivative of a widely accepted code, and extended it to increase the efficiency of her method. The extended Rice algorithm has since been designed in silicon circuits suitable for space flights. These circuits have been integrated in several space missions, including the Small Satellite Technology Initiative Lewis spacecraft, and for software onboard the Mars Observer and Goddard's Submillimeter Wave Astronomy Satellite.

Yeh's data compression technology is under consideration to become an international standard for space data systems.

"Dr. Yeh has extended a method for data compression which will benefit NASA and industry as well," said Warner Miller, Panel Chairman of the Consultative Committee for Space Data Systems. "The data compression method already has been endorsed by industry and universities."

Yeh was honored for her advancements in encoding digital data at a NASA Headquarters ceremony this month.

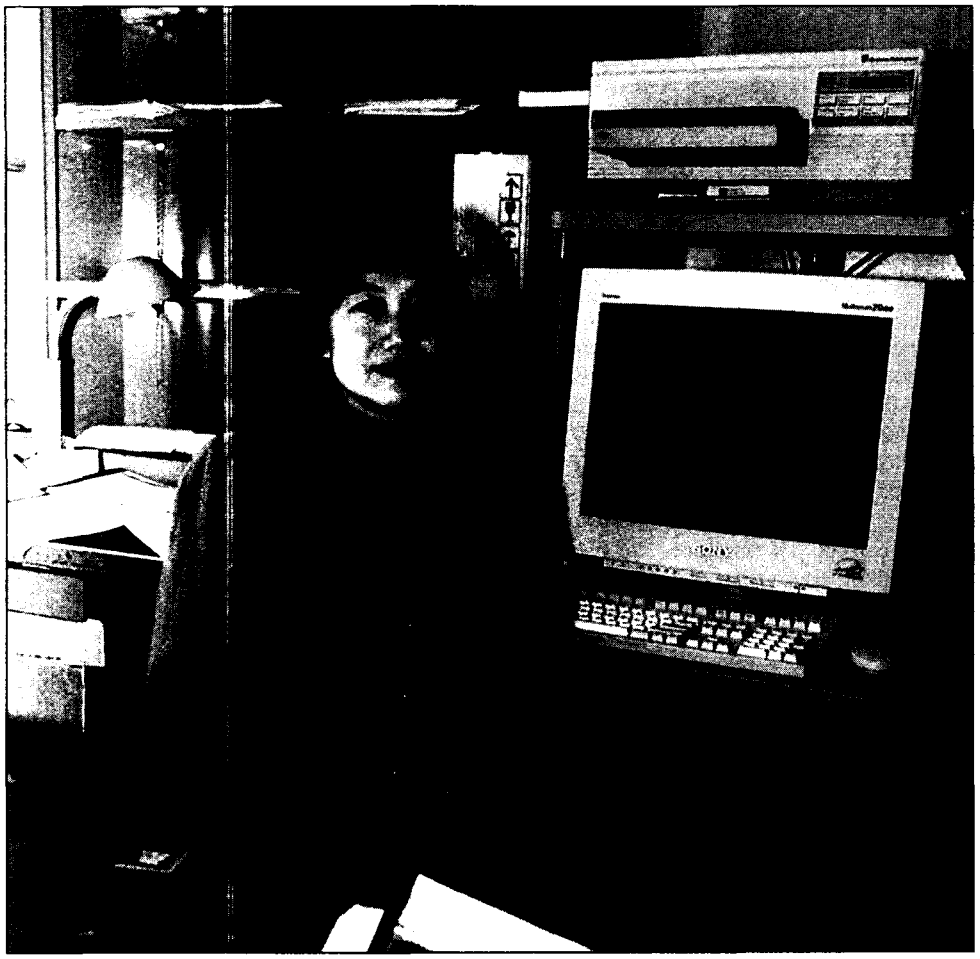
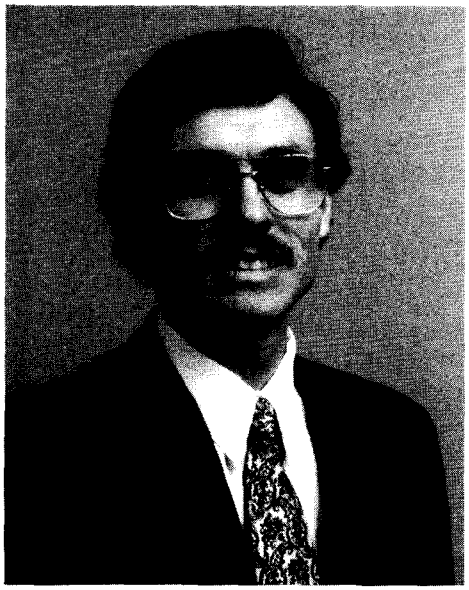


Photo by Marc DeBord

Pen-Shu Yeh, creator of the Method for Coding Low Entropy Data, is shown in her office.

Recent key appointments at Goddard

Photo by Marc DeBord



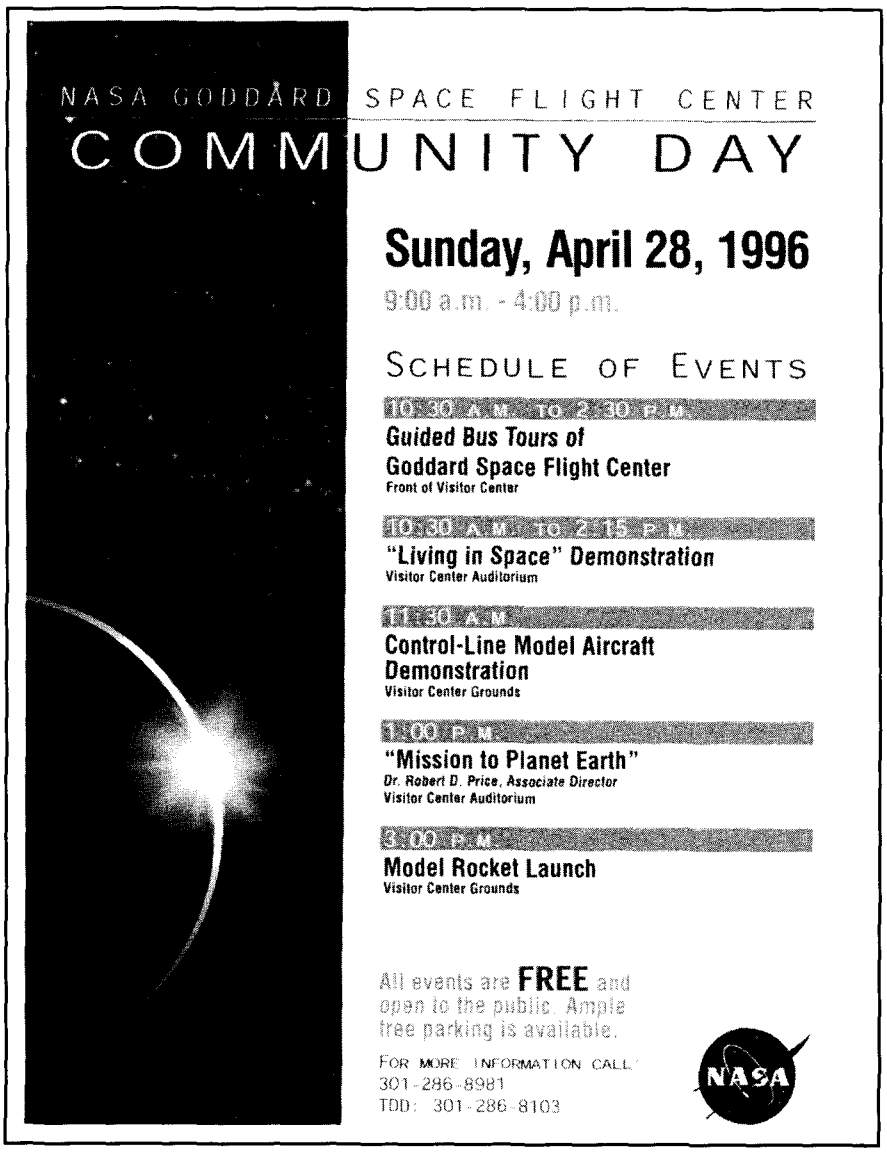
Philip Liebrecht

In March **Philip Liebrecht** became Chief of the Networks Division, replacing the retiring Daniel Spintman. Liebrecht formerly was the Associate Chief for Space Networks, a position he held since June 1993. He was responsible for the development, maintenance and operation of the Space Network and its components; the Tracking and Data Relay Satellites (TDRS), the White Sands Complex, the Network Control Center and the Compton Gamma Ray Observatory and the Remote Terminal System.

The Networks Division is responsible for planning, budgeting, management, development and operation of all ground support systems, ground stations and network facilities of NASA's space and ground networks including operation of the TDRS.

Jonathan Hartley was appointed Chief of the Data Systems Technology Division recently. He succeeds David Howell who took an assignment at NASA Headquarters. Hartley leads the Directorate efforts in applying and evaluating advanced technology in computer science and engineering to evolve the next generation of mission communications and data systems.

Hartley had been the Associate Chief of the Data System Technology Division since January 1993 and was responsible for planning and managing the development of advanced systems architectures and technology prototypes.



Goddard hosts Outreach Fair

Goddard hosts it's first Community Outreach Fair for Goddard employees May 21 from 10 a.m. to 1 p.m. in the Building 8 Auditorium. The purpose of the fair is to promote volunteerism and provide an opportunity for employees to talk to volunteer coordinators from public and private service organizations.

The Prince George's Voluntary Action Center, Montgomery County Volunteer and Community Service Center are participating along with Doctor's Community Hospital, Food & Friends, Jewish Council for the Aging, PG Memorial Library, Greenbelt Cares, Goddard's Visitor Center, Bowie SPCA and the Whitman-Walker Clinic of Suburban Maryland.

Many school systems require students to participate in community service. So you may find a volunteer organization where you and the 'student in your household' can take part in community service activities.

Goddard's Community Outreach Fair is sponsored by the Office of Public Affairs. For more information call Nina Desmond at 286-8141.

Goddard reaches out

Ten years ago, the word "outreach" never appeared in the NASA vocabulary. Today, the word is used so frequently as to diminish its meaning and potential impact of its message for the Agency.

Outreach, as envisioned by NASA Administrator Dan Goldin, and pursued by Goddard Space Flight Center Director Joe Rothenberg, means increasing the knowledge of NASA's impact on society. However, outreach is not accomplished by a special office. It is an important aspect of all we do.

"We are headed in the right directionhere at Goddard," said Kathy Nado, special assistant to Rothenberg for Outreach. "We are approaching it with three emphasis: education, technology transfer and public awareness. Our message, tailored to each individual audience, should extend the knowledge and understanding of Goddard's mission and goals. For successful implementation of a Goddard Outreach strategy, we must have wide ownership and clear implementation without stifling enthusiasm, initiative and creativity."

From an education standpoint, the Challenger Centers "did a wonderful job of getting us moving in the right direction through interactive curriculum developed in concert with educators and with the audience in mind," Nado said. "However, one of our roles at Goddard, with respect to education and outreach, is not necessarily to encourage students to enter into the science or technology fields, or even to become an astronaut. Through education, our goal is to develop effective implementations to make the results and the process of science available to both students and the public."

Nado said she is also encouraging more emphasis on technology transfer commercialization at Goddard. While the center generates a significant amount of technology available to transfer to private industry, getting the word is a challenge. "From a process standpoint, an invention disclosure is required before a patent application is processed, and an innovation disclosure is necessary for a process improvement." This step is a must before the next step, when an article appears in any publication, including the NASA Tech Briefs magazine.

The third aspect of outreach is communication with the public at-large. While the public affairs office is accomplishing much in this area, its numbers are limited and assistance from all organizations across the center is needed if the center is to generate the level of public awareness envisioned by NASA managers. A new committee, chaired by PAO and with membership from every Goddard directorate, is developing criteria and initiatives to enable greater public awareness.

Goddard News NASA
National Aeronautics and Space Administration Goddard Space Flight Center

The GODDARD NEWS is published monthly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

Deadline to submit material is the first of each month. For additional information contact Fred Brown (301) 286-8955.

The GODDARD NEWS Staff is:

Executive Editor: Jim Sahli
Managing Editor: Fred Brown
Contributing Editors: Donna Drelick, Tammy Jones, W. Allen Kenitzer, Ernie J. Shannon

Cover Story

continued from Page 1

straints of shrinking budgets. According to Rothenberg, "the Center will identify opportunities through a 'New Initiative Process' that establishes a cross-Center priority on initiatives and applies the resources to make them happen."

The New Millennium Mission illustrates Goddard's future in these changing times. Under Goddard project management, the focus of the first mission is the Advanced Land Imager which will enable first class science by validating breakthrough technology. The Advanced Land Imager will be developed from instrument technologies proposed by members of the existing New Millennium Integrated Product Develop-ment Teams which includes industry partners. The spacecraft support structure will be provided by Swales & Associates, Inc., and Litton Industries. The power and data subsystems will be provided through a Space Act cost-sharing agreement that calls for Litton to develop the hardware and integrate it into the New Millennium spacecraft, while providing the company with a two-year license to commercialize the technology. "This innovative arrangement, which includes a major commitment from Litton to integrate and deliver the hardware, represents an exciting new way of doing business for Goddard," said Rothenberg.

Other major new missions coming to Goddard are part of the Medium-class Explorer (MIDEX) program. NASA's Office of Space Science selected for definition studies leading to confirmation and development two Goddard proposals, The Microwave Anisotropy Probe (MAP) and the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE). In addition to the two primary missions, two alternate missions also proposed by Goddard were chosen to receive minimal funding for study. The Explorer Project Office at Goddard will manage the MIDEX mission development for NASA's Office of Space Science. The MIDEX missions are a new component of the Explorer program, designed to complement the Small Explorer and the proposed University Explorer program. The Explorer program was restructured to permit more frequent, low-cost launch opportunities, with no more than three years from the design and development phase to launch. The MIDEX program is intended to provide research opportunities in the areas of astrophysics and space physics. Plans call for about one MIDEX mission to be launched per year, with development cost capped at no more than $70 million each.

New ways of doing business will create new opportunities and challenges for the GSFC workforce. "No matter how effective we think our programs are, we will continually be challenged to improve. The challenges will come from Congress, from the science community, from our customers," said Rothenberg. "In the future, we will have to continually be looking for ways to improve and to become even more effective and competitive."

National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

May 1996 Vol. 43 No. 15

INSIDE

2 Director's Update

2 New Millennium

5 Space Pods and Knots

6 In Memoriam: Hongsuk H. Kim

7 Space Launch Honorees

A new look at the Sun

By Jim Sahli

Initial observations by the recently launched Solar and Heliospheric Observatory (SOHO) spacecraft reveal unexpected activity on the Sun and the best views yet of the sources of strange, chaotic "plume" structures that extend from the solar poles to high altitudes within its outer atmosphere, or corona.

SOHO was specifically designed to observe the Sun during a supposedly "quiet" period near the bottom of its 11-year sunspot cycle, when solar disturbances are at a minimum and the undisturbed solar atmosphere and interior could best be studied.

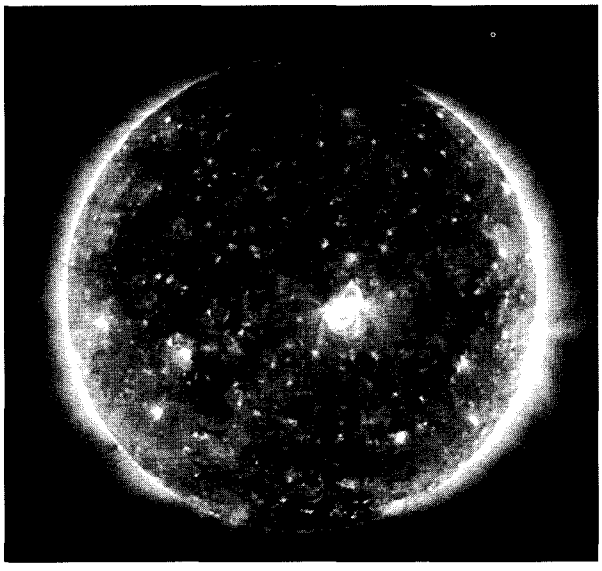
To the surprise and excitement of SOHO's scientific investigators, "movies made from SOHO ultraviolet data show there is continuous motion and action everywhere on the Sun," said Dr. Joseph Gurman of Goddard.

Disturbances are occurring even within so-called "coronal holes," areas of particularly low density, low temperature and open magnetic field lines in the corona where such disturbances were least expected. An open magnetic field is one in which the lines of magnetic force stretch out indefinitely into interplanetary space, rather than looping back downward onto the Sun.

The dramatic new ultraviolet movies from SOHO also have revealed the source areas of the long, feathery plumes that extend from regions near the poles of the Sun to more than 13 million miles into interplanetary space. The sequences of ultraviolet images, combined into movies by SOHO researchers, show the polar plumes standing in the solar wind, an outward streaming of electrified gas from the corona. The movies clearly reveal the bases of the plumes, never characterized before, to be seething regions of wildly gyrating magnetic fields and turbulent solar gases.

"Polar plumes are a natural laboratory to explore two of the main objectives of the SOHO mission," explained Dr. Craig DeForest of Stanford University, Palo Alto, Calif. These goals are to learn how the Sun's corona is heated to about 3.6 million degrees Fahrenheit and why the solar wind in some places reaches speeds of almost 2 million miles per hour. The plume data may even shed light on the third main goal of SOHO, to determine what occurs below the solar surface to generate the strong flows and intense magnetism that produce solar disturbances such as sunspots and solar flare explosions.

The chaotic conditions discovered by SOHO at the base of the polar plumes are also under analysis. Early data show that often the base of a plume is a bright point in the solar atmosphere, as seen in ultraviolet light. These bright points fluctuate rapidly in intensity and are at locations where magnetic fields are rapidly changing. "These magnetic changes may represent the release of significant amounts of energy on the Sun, and they contribute to the heating of the corona," according to NASA's Gurman.



NASA/ESA Image

This image illustrates 1.5-million degree Celsius gas in the Sun's thin, outer atmosphere (corona) taken March 13, 1996 by the Extreme-ultraviolet Imaging Telescope which is onboard the Solar and Heliospheric Observatory (SOHO) spacecraft. Every feature in the image traces magnetic field structures. Because of the high quality instrument, researchers can see more subtle and detailed magnetic features than ever before. This image is the first time scientists have been able to get such images except during five-minute rocket flights. Because of SOHO's view of the Sun, science researchers have been able to make movies that show the dynamic, ever changing nature of the "quiet Sun."

A chief aim of the SOHO polar plume research is to see if plumes can be positively identified as the sources of high-speed streams of solar wind that were directly sampled by the European Space Agency's Ulysses spacecraft when it passed over the poles of the Sun in 1994 and 1995. In earlier work with sounding rocket experiments, DeForest concluded that the plumes may contain high-speed outward gas flows. "Now, we are trying to determine whether the plumes are in fact the fundamental source of the high speed streams," he said.

The dramatic changes found at the foot of the polar plumes "appear to include the breaking open of small

Continued on page 4

Director's Update

by Joe Rothenberg

I believe that the Center must redirect civil servants into areas of work which have a new emphasis consistent with the roles and missions assigned to Goddard by the Agency. A major challenge in implementing these shifts is matching the skills of available employees to the required skills of the available work of the future.

The successful launch of several flight projects, the near term completion of other projects, and the availability of civil servants who are supporting areas that will be reshaped in the future affords us an immediate opportunity to proactively reconfigure the future of the Center and its workforce.

Center management is committed to making these matches through voluntary transfers. As I announced in recent Center Town Meetings and All-Hands addresses, reassignment opportunities will be prominently displayed. Additional training and career development activities will be provided, as necessary, to ease the transition for employees who are interested in changing organizations and/or career directions.

More than 30 opportunities at the Center have already been identified. Additional positions will be identified in the near future. These opportunities are now being publicized throughout the Center in a variety of ways.

The first, Refocusing Opportunity Notices, will be sent to employees through mailroom distribution, posted on vacancy announcement bulletin boards in buildings around the Center, and available electronically on the Office of Human Resources Home Page (http://ohr.gsfc.nasa.gov, then click on "Information for GSFC Staff," then click on "Reassignment Opportunity Bulletins"). These Refocusing Opportunity Notices contain information about specific positions, eligibility requirement for non-competitive consideration, how to apply, and a point of contact to obtain additional information.

Let me reiterate that employees are encouraged to apply not only for the opportunities for which they may already be fully qualified, but also for opportunities in areas of work for which they do not possess the experience. If selected, additional training and development necessary to reach full capability in the job will be assessed with the help of the Employee and Organizational Development Office.

New Millennium first mission selected

By Ernie J. Shannon

An advanced, lightweight scientific instrument designed to produce visible and short-wave infrared images of Earth's land surfaces has been selected as the focus of the first NASA New Millennium program mission dedicated to the agency's Mission to Planet Earth enterprise. The project will be managed by Goddard.

The capabilities of the Advanced Land Imager instrument to be demonstrated on the flight will serve multiple purposes, according to Dr. Charles Kennel, NASA Associate Administrator for Mission to Planet Earth.

The new instrument will demonstrate remote-sensing measurements of the Earth consistent with data collected since 1972 through the Landsat series of satellites, which is used by farmers, foresters, geologists, economists, city planners and others for resource monitoring and assessment. In addition, it will acquire data with finer spectral resolution, a capability long sought by many elements of the Earth observation data user community, and it will lay the technological groundwork for future land imaging instruments to be more compact and less costly.

"We looked at nearly a dozen different mission concepts in some detail, and a land surface imaging mission clearly was at the top of this year's priority list," Kennel said. "It will ultimately enable first-class science, by validating breakthrough technology with clear potential capabilities, both commercially and to the future of NASA's Earth Observing System."

As designed, the Advanced Land Imager represents an approximate sevenfold decrease in mass and electrical power usage demands compared to the current Landsat 5 multispectral instrument. In addition, it extends the existing measurement capabilities through the incorporation of an advanced high resolution hyperspectral imaging "spectrometer-on-a-chip." This novel, wide-field observing system requires no scan mirror. It is built around a lightweight integrated silicon carbide structure and optical system, with an innovative in-flight calibration system.

The Advanced Land Imager will be developed from instrument technologies proposed by members of the existing New Millennium Integrated Product Development Teams.

For this mission, the team of industry partners will be led by the Massachusetts Institute of Technology's Lincoln Laboratory, Lexington, Mass., a federally funded research and development center. Lincoln Lab and its partners will provide open access to U. S. industry regarding the design and performance of the Advanced Land Imager, with the explicit purpose of expediting the transfer of this technology into the commercial sector.

The instrument will feature ten-meter ground resolution in the panchromatic (black-and-white) band and 30-meter ground resolution in its other spectral bands, using a four-chip multispectral focal plane array that covers seven of the eight bands of the current Landsat. Hyperspectral capabilities, which further split these bands into highly differentiated images, will be tested to show that they can be combined into traditional Landsat-equivalent data sets.

"The combination of multispectral and hyperspectral capabilities in a future operational system would preserve and continue the invaluable Landsat-based record of global land cover change, while opening up new windows on the Earth in areas like precision vegetation studies and more accurate mineral identification," Kennel said.

The spacecraft support structure, including advanced electrical power and data-handling subsystems, will be provided by Swales & Associates, Inc., Beltsville, Md., and Litton Industries, College Park, Md. The effort also will incorporate advanced spacecraft technologies made available through the New Millennium Integrated Product Development Teams.

The power and data subsystems will be provided through a Space Act cost-sharing agreement that calls for Litton to develop the hardware and integrate it into the New Millennium spacecraft, while providing the company with a two-year license to commer-

Continued on Page 8

XTE discovers fluctuations in intensity of X-ray emissions

by Jim Sahli

Astronomers working with NASA's Rossi X-Ray Timing Explorer (XTE) spacecraft have discovered rapid fluctuations in the intensity of X-ray emissions from three unusual binary star systems that appear to be the signatures of the fastest vibrations ever detected in celestial objects.

In one case, the oscillations reached frequencies as high as 1,130 times per second. The new findings were reported April 30 at a meeting of the High Energy Astrophysics Division of the American Astronomical Society in San Diego, Calif.

The observations made using Rossi XTE offer scientists a new window on the strange physical conditions that scientists envision on neutron stars, which are believed to form when massive stars reach the ends of their lives and then explode as supernovas. The outer layers of a supernova are expelled into space, while its inner core remains and becomes a neutron star. Unlike normal stars, which are balls of hot gas, neutron stars are believed to possess solid crusts.

The first detection of the remarkable fluctuations by Rossi XTE was made in February 1996. Astronomers led by Dr. Tod Strohmayer of the Universities Space Research Association (USRA) at Goddard were observing the binary star 4U 1728-34, located in the general direction to the center of the Milky Way galaxy in constellation Sagittarius.

This star pair was already well known to astronomers as a frequent source of powerful bursts of X-rays, which are thought to originate in hot gas that has streamed downward onto a very small and dense star known as a neutron star from a companion star. As the gas accumulates on the neutron star, it turns into a natural nuclear bomb, burning with a thermonuclear flash that produces a burst of X-rays lasting about 10 seconds.

Fortunately, 4U 1728-34 was in a bursting state when the Rossi XTE observations commenced. The astronomers were able to detect both the powerful bursts and the weaker "persistent" X-ray emission that is always emanating from the binary star.

"We were very excited to catch several X-ray bursts in our first pointing at the object. We were even more excited when a quick look at the persistent X-ray data revealed very high frequency oscillations which no one had ever seen before," said Strohmayer. "The observations seem to confirm long-standing theoretical ideas suggesting that physical conditions on a neutron star can change in less than one millisecond." (A millisecond is one-thousandth of a second.)

The oscillations detected in 4U 1728-34 occurred at varying rates, reaching as high as 1,100 times per second. In subsequent Rossi XTE observations, investigators under Michiel van der Klis of the University of Amsterdam, The Netherlands, have detected even faster oscillations in X-rays emitted by the binary star system Scorpius X-1, which is named for the constellation in which it is located.

Scorpius X-1 was the first object beyond the solar system to be detected as a source of X-rays. In Scorpius X-1, the oscillations observed with the Rossi XTE have reached rates as high as 1,130 times per second.

Further observations by the spacecraft's instruments have found oscillations of up to 900 times per second in a third binary star, 4U 1608-52, in the constellation Norma. Research on that star was led by Jan van Paradijs of the University of Alabama, Huntsville, and the University of Amsterdam, and by Dr. William Zhang of USRA, who is also from Goddard. Each of these three binary star systems contains a neutron star, and all of them are located in the southern sky.

"It's possible that the oscillating X-ray emissions come from gas orbiting very close to the neutron star," according to Strohmayer. For example, material orbiting at 10 miles above a neutron star would circle it about 700 times per second. "We have also measured a 363 times per second oscillation during the bursts from 4U 1728-34. This may be the period at which the neutron star is spinning," he added. Other Rossi XTE data support this interpretation.

"A more controversial possibility," he added, "is that we may be detecting for the first time the influence of waves on the surface of the neutron star or within its solid crust." Such waves occur in the gaseous layers of the Sun and other stars, but have not previously been found in neutron stars. "The detection of such waves might allow us to probe the unseen interiors of neutron stars, just as seismologists use earthquake waves to explore the inner layers of the Earth."

The possibility that the Rossi XTE has detected actual waves in neutron stars or a very fast rotation period of one such star is of great scientific interest, says Dr. Jean Swank, RXTE Project Scientist at Goddard and a collaborator in the research on all three binary star systems. If surface waves have been detected, that would be a scientific first. If a very fast rotation period has been detected in a neutron star in an X-ray binary system, the finding would tend to confirm a theory that certain very fast radio pulsars, known to be rotating neutron stars, are descended from fast-rotating members of X-ray binaries.

In any case, "we have succeeded in one of our prime goals for this spacecraft, to detect and characterize rapid changes in celestial X-ray sources that may reveal their underlying physical conditions," Swank said.

XTE was launched by a Delta II rocket on Dec. 30, 1995. Subsequently, NASA renamed it in honor of the late Professor Bruno Rossi of the Massachusetts Institute of Technology in Cambridge, one of the pioneers of X-ray astronomy. The Earth-orbiting spacecraft carries the largest X-ray detector yet flown in space, the Proportional Counter Array, which was developed at Goddard by Swank and her team members.

Space Flight Awareness

Technology Experiments for Advancing Missions in Space (TEAMS)

Aboard Space Shuttle Endeavour when it begins the STS-77 mission in May will be a Goddard-managed Hitchhiker (HH) carrier.

The carrier will be loaded with four experiments called Technology Experiments for Advancing Missions in Space (TEAMS). Those experiments are the Global Positioning System (GPS) Attitude and Navigation Experiment (GANE); the Vented Tank Resupply Experiment (VTRE); the Liquid Metal Thermal Experiment (LMTE) and the Passive Aerodynamically Stabilized Magnetically Damped Satellite (PAMS).

The Hitchhiker is a primary Shuttle payload of STS-77. Of the four experiments, one is a Goddard project. The experiments are flown together at reduced cost and with the Hitchhiker carrier providing the needed resources (power, data, etc.) to each experiment.

The Hitchhiker carrier can carry equipment mounted in canisters and also has mounting plates of various sizes for user equipment. The carrier provides electrical power, command signals, and "downlink" data interfaces. Hitchhiker customers operate their payloads from a Goddard control center using their own ground support equipment (usually a personal computer) to send commands and display data.

The Goddard Passive Aerodynamically Stabilized Magnetically Damped Satellite (PAMS) experiment is a technology demonstration of the principle of aerodynamic stabilization. PAMS consists of a small deployed satellite and a measuring system to observe the satellite during the Space Shuttle mission.

Aerodynamic stabilization is a method that can be used to position a satellite in a specific orientation while in low Earth orbit. Aerodynamic stabilization works the same way as a dart. The front of the dart is weighted and once the dart is thrown, it will always right itself with the head facing forward. In the same manner, the PAMS satellite will eventually be oriented with the heavy end facing forward in orbit. This principle can be used to partially control the attitude of small satellites.

Most instruments need a satellite to point at a specific feature that will be measured from space, such as telescopes. For instruments that do not have precise pointing requirements, aerodynamic stabilization can be used with other methods to obtain the desired orientation. A satellite can be aerodynamically stabilized by building it heavy at one end, but well balanced. Designing satellites that use this principle means that a simpler attitude control system can be used on the satellite, making the satellite less complicated, more reliable, and cost-effective.

Cameras on the Shuttle will record the satellite as it is deployed. Later during mission the Shuttle will rendezvous with the satellite on two separate days. The Shuttle will trail 2,000 feet behind the satellite and point the PAMS measuring system. The cameras aboard the Shuttle will record the satellite movements over eight orbits.

NASA SCIENTIST ELECTED TO NATIONAL ACADEMY OF SCIENCES

Dr. James E. Hansen, Chief of the Goddard Institute for Space Studies (GISS), New York, a division of Goddard Center, has been elected to the National Academy of Sciences. This honor is bestowed annually on individuals or team in recognition of significant contributions to science.

Hansen began his career at GISS from 1967 as a National Research Council Resident Research Associate. He came to GISS full-time in 1972 as a space science researcher. In 1981, he was appointed as Chief of the Goddard Institute for Space Studies. He has served as principal and co-principal investigator on several planetary missions including the Galileo (Jupiter Orbiter) Deep Space Probe. Most recently, he has specialized in the broad study of global change on earth.

Hansen has received NASA awards for his contributions to the Galileo mission and a NASA Exceptional Service Medal for his work in radiative transfer. He received a public service award from the National Wildlife Federation.

In addition to his duties at NASA, Hansen is an adjunct professor at Columbia University in the Department of Geological Sciences.

A native of Denison, Iowa, Hansen graduated from the University of Iowa in 1963, in Iowa City, where he received a bachelor of science degree (with the highest distinction) in physics and mathematics, a masters of science in astronomy in1965, and a Ph.D. in physics in 1967. Hansen and his wife, Anniek, live in Ridgewood, N.J., and have two children.

A new look at the Sun

Continued from page 1

magnetic arches to form 'jets' that expel mass at coronal temperatures," Gurman added. Such jets have been observed in the X-ray portion of the spectrum by a telescope on Japan's Yohkoh spacecraft, "but this is the first time that small-scale jets have been observed outside large active regions on the Sun," he said. "In fact, we are seeing them in a coronal hole at the south pole, along with the plumes."

Much of the new information on polar plumes and on the unexpected disturbances on the "quiet Sun" comes from the SOHO Extreme-ultraviolet Imaging Telescope (EIT). Dr. Jean-Pierre Dela-boudiniere, of the Institut d'Astrophysique Spatiale, Orsay, France, is principal investigator for EIT. The EIT images show the portion of the plumes from their bases in the solar surface layer out to heights of about 93,000 miles. At its base, a plume is about 1.5 times as wide as the diameter of the Earth. (The diameter of the Earth is 7,928 miles.)

Other important information comes from SOHO's Michelson Doppler Imager (MDI), which measures underlying magnetic fields and gas flow patterns on the solar surface, and from the Large-Angle Spectroscopic Coronagraph (LASCO), which images the plumes as far as 30 solar radii from the surface of the Sun. (The radius of the Sun is about 440,000 miles.) Professor Philip Scherrer of Stanford University is the principal investigator for MDI and Dr. Guenther Brueckner of the Naval Research Laboratory, Washington, D.C., is the principal investigator for LASCO.

SOHO is on location in space near the L-1 Lagrangian point, where the Earth's and Sun's gravitational forces balance, some one million miles sunward from the Earth. This vantage point enables solar astronomers to observe the Sun continuously, with no intervening "night."

SOHO is a project of international cooperation between NASA and the European Space Agency. It was launched on Dec. 2, 1995 from the Cape Canaveral Air Station, Fla. The Extreme-ultraviolet Imaging Telescope is the product of laboratories in France, Belgium, and the U.S. The Large-Angle Spectroscopic Coronagraph was fabricated at laboratories in the U.S., Germany, France, and the United Kingdom. The Michelson-Doppler Imager was produced at laboratories in the United States.

Space Pods and Knots viewed by Hubble

by Tammy Jones

Resembling a bizarre setting from a science fiction movie, dramatic images sent back by NASA's Hubble Space Telescope have surprised astronomers by uncovering thousands of gigantic tadpole-shaped objects surrounding a dying star.

Dubbed "cometary knots" because their glowing heads and gossamer tails superficially resemble comets, they are probably the result of a dying star's final outbursts. Although ground-based telescopic observations have hinted at such objects, they have not previously been seen in such abundance, say researchers.

The knots were detected by Hubble astronomer C. Robert O'Dell and graduate student Kerry P. Handron of Rice University in Houston, while exploring the Helix nebula, a ring of glowing gases blown off the surface of a sunlike star late in its life.

O'Dell expects the gaseous knots, which are each several billion miles across, will eventually dissipate and vanish into the cold emptiness of interstellar space. However, he speculates that if the objects contract to form permanent solid bodies, they may contribute to a fraction (less than ten percent) of the missing mass of our galaxy, simply because of their sheer abundance around a typical dying star.

The mysterious "space pods" came into view as O'Dell used Hubble's Wide Field Planetary Camera-2 to survey the Helix nebula, located 450 light-years away in the constellation Aquarius and the closest planetary nebula to Earth — so close that its angular size is almost half that of the full Moon.

The most visible cometary knots all lie along the inner edge of the ring, at a distance of trillions of miles from the central star. Their comet-like tails, each stretching a hundred billion miles, form a radial pattern around the star like the spokes on a wagon wheel. Though previous ground-based observations show a spoke pattern in the Helix, and some structure, O'Dell emphasizes that the Hubble images reveal an underlying population of many more smaller objects.

O'Dell made the observation because he was curious if these objects were the result of the star's final outburst which would bring comets out of "cold storage" by boiling off the icy, solid comet nuclei. This is how comets behave as they swing near our Sun.

The knots have just the right appearance and are at just the right distance from the dying star to be a long-sought comet cloud — much like the hypothesized Oort cloud encircling our solar system. However, each gaseous cometary "head" is at least twice the diameter of our solar system — far too large for the gaseous shell, called a coma, that surrounds an active comet as we know it.

The most likely explanation is the objects have been formed during the final years of a star's life when it ejects shells of gas into space. This "planetary nebula" formation happens in stages where, toward the end of the process, a faster moving shell of gas ejected off the doomed star collides with slower moving gas released ten thousand years before.

Standard models predict that the knots should expand and dissipate within a few hundred thousand years. However, dust particles inside each gas ball might collide and stick together, snowballing to planet-sized bodies over time. The resulting objects would be like Earth-sized copies of the frigid, icy planet Pluto. These icy worlds would escape the dead star and presumably roam interstellar space forever.

If this phenomena is common among stars, then our galaxy could be littered with trillions of these objects, O'Dell concludes. "Planetary nebulae have been formed in our galaxy for billions of years and about one new one is created every year since this is the usual ending for the billions of sunlike stars inhabiting our Milky Way galaxy."

Hubble will be used to search more distant planetary nebulae for similar features. O'Dell hopes to revisit the Helix in a few years and take more images which might reveal the outward motion of the knots.

MOST AMBITIOUS SPARTAN MISSION

Goddard's Spartan 207 and the Jet Propulsion Laboratory's Inflatable Antenna Experiment (IAE) together make up the Spartan 207/IAE, a primary payload scheduled for deployment this spring during Mission STS-77.

According to Mark Steiner of the Special Payloads Division and the Spartan 207/IAE Mission Manager, this is the most ambitious Spartan mission ever undertaken.

The IAE is an inflatable, deployable, antenna reflector structure that is 50 feet in diameter and is mounted on three 100 foot struts. Once inflated, a camera will monitor the IAE for any problems. The Spartan carrier is rectangular in shape with experiments occupying half its volume and support systems occupying the rest.

The mission objective is to validate and characterize the mechanical function and performance of a 14-meter-diameter inflatable deployable antenna reflector structure in the space environment.

On Flight Day Two after deployment and the Shuttle moves the proper distance from the Spartan, a command will be issued to begin the inflation sequence. During this sequence the IAE will be illuminated and photographed. The experiment takes approximately 90 minutes to complete. At the conclusion of the experiment on Flight Day Three, the IAE is jetissoned from Spartan 207. The Shuttle then rendezvous with and retrieves Spartan 207.

11 GAS Payloads on STS-77

The Get Away Special Project, which is also managed by the Special Payloads Division, is flying 11 payloads on STS-77. The project has been in operation for 14 years and allows students, individuals or organizations an opportunity to perform experiments on the Space Shuttle.

GAS experiments on this mission are from the following organizations: California Institute of Technology, The German Space Agency, NASA Lewis Research Center, Utah State University, The Canadian Space Agency, Penn State University, and The European Space Agency.

After this mission, GAS would have flown 138 payloads. While opportunities for flying GAS payloads will be slim for the next two years, Clarke Prouty, GAS mission manager, says once the International Space Station flights begin, GAS will be very active. To date, 446 applications have been submitted for payload reservations.

Goddard host to a record turnout for Community Day

by Nina Desmond

It may have been the great weather, or perhaps an increased interest in space exploration, or possibly excellent public awareness efforts. Something managed to bring a record turnout of 6,100 visitors to Community Day on April 28. Whatever the reason, Goddard's Spring Open House was a huge success.

Dr. Robert Price gave a special presentation on NASA's Mission to Planet Earth to standing room only crowds. All who attended came away with a better understanding of this crucial NASA program and Goddard's important contributions to Earth Science.

The Goddard Amateur Radio Club and the Goddard Model Airplane Club continued their long standing tradition of participation at Community Day. The clubs demonstrations proved as popular as ever.

The RXTE Project was represented throughout the day by Dr Jim Lochner. Also, the Facilities Management Division in celebration of Earth Week provided a display on energy saving lighting and environmental issues.

"All the credit for such a successful Community Day goes to the Visitor Center Team Volunteers and all the Goddard employees who volunteered their valuable time to host our tour facilities", says Steve Moore, assistant manager of Goddard's Visitor Center.

Photo by Marc DeBord

Visitors to Goddard's Community Day look at model rockets at the Visitor Center.

In Memoriam

Hongsuk H. Kim passed away suddenly at Goddard May 8th while playing soccer with the Goddard League after work. Hongsuk began his career at NASA thirty years ago at the Electronics Research Center in Cambridge, MA after receiving his M.S. in Physics from Northeastern University. When the Center closed he went to Wallops where he spent six years and pioneered in lidar ocean bathymetry and fluorescence research. The legacy of this work is the Airborne Oceanographic Lidar currently at WFF. He transferred to Greenbelt twenty years ago where he became the principal investigator in developing the Ocean Color Experiment. This was one of four experiments which flew on the Space Shuttle's maiden flight to include science experiments (SPS-2), resulting in his receiving a special Presidential citation from Ronald Reagan in a ceremony at the Smithsonian. He continued to work with atmospheric, land, and oceanic energy processes. He was currently testing the use of lasers for measuring atmospheric temperature using Brillouin scattering. He also had submitted ground breaking research on the role of solar forcing in climatic changes which will have an impact on how the significance of the greenhouse effect will be viewed. Mr. Kim leaves a wife, Armida, and three sons.

2 Goddard employees selected for the 1996 astronaut class

Two Goddard Space Flight Center employees are among 35 individuals selected for the 1996 astronaut class.

Dr. Piers Sellers of the Laboratory for Terrestrial Physics in the Earth Sciences Directorate and Paul Richards of the Space Technology Division of the Engineering Directorate will report to the Johnson Space Center in Houston in August to begin a two-year training program. They will be joined by 33 others which represents the largest astronaut class since 1979.

"It's the culmination of a life-long dream," said Sellers who first became enthralled with the space program watching the Apollo astronauts from his home in England. "I've known since those days that I wanted to pursue space flight."

For Richards as well, it has been a long effort. "I first applied to the astronaut program before I was old enough to qualify because I wanted to become familiar with the process."

Sellers and Richards report to Houston Aug. 12 where they will begin a year's worth of training and evaluation. After another year or so, they will be assigned to a Space Shuttle mission.

Shuttle Launch Honorees view STS-76

On March 22, after a 24-hour delay due to high winds, Goddard Space Flight Awareness Launch Honorees got to view the 3:13 a.m. launch of the STS-76 from the VIP viewing site at Banana Creek. The flight was the third of nine planned Space Shuttle–Mir link ups between 1995 and 1998, including rendezvous, docking and crew transfers, which will pave the way toward assembly of the International Space Station beginning in November 1997.

In addition to a VIP tour of KSC, the honorees attended a reception held in their honor with astronauts and high level management in attendance to congratulate them. In a separate ceremony, astronaut Dave Walker, a veteran of four Space Shuttle missions, presented the Goddard honorees with their Certificate of Merit and pin.

This NASA-sponsored award recognizes individuals for their exceptional dedication to quality work and flight safety. It is one of the highest and most prestigious awards available to employees of the NASA/ industry Space Shuttle/payloads team.

The next Space Flight Awareness Launch Honoree Event will be held in conjunction with the STS-79 mission, currently scheduled for launch July 31, 1996.

Photo by Marc DeBord

Honorees pictured left to right: Jerry Zgonc/542; Denis McCloskey/Lockheed Martin Technical Operations Company, Inc.; Cheryl Dry/Allied Signal Technical Services Corporation (ATSC); Avanaugh Showell/ATSC; Roy Idehara/Lockheed Martin Missiles and Space Company, Inc.; Russ Snyder/Swales and Associates, Inc.; Marc Harlacher/Stanford Telecommunications, Inc.; Eric Krupacs/442; Mary Galloway/ Computer Sciences Corporation (CSC); Paul Nelson/CSC; Doug Ward (CSC); and Jody Fillman/205.1. Not available for photo: Mark Lupisella/511 and Sara Leung/ATSC.

Photo by Marc DeBord

NASA's Charles Kennel is shown receiving a momento from, left, Center Director Joe Rothenberg, Deputy Director Al Diaz, Earth Science Director Dr. Vince Salomonson and Associate Director for Mission to Planet Earth Dr. Bob Price. Kennel departed the Agency in May.

Boricuas en la NASA

"Boricuas en la NASA," or Puerto Ricans at NASA, was the headline of the Jan. 14 Sunday Magazine of *El Nuevo Dia,* the primary Spanish language newspaper of Puerto Rico. The artlicle highlighted the many achievements of 31 graduates of the University of Puerto Rico, Mayaguez who are currently working at Goddard. The article has brought fame to those who appeared in it, both locally and on the island, and even resulted in a special declaration by the Senate of Puerto Rico recognizing them for being role models for Puerto Rican youth.

A New Millennium mission

Continued from page 2

cialize the technology. "This innovative arrangement, which includes a major commitment from Litton to integrate and deliver the hardware, represents an exciting new way of doing business for Goddard," said Center Director Joseph Rothenberg.

Further potential industry partnerships in the mission beyond those already identified will be solicited in a workshop to be held during upcoming advanced definition studies.

The total NASA cost of the first New Millennium Earth science mission, including its Small Expendable Launch Vehicle, has been capped at $90 million. Launch is planned for late 1998.

The current mission operations concept for the New Millennium flight has the spacecraft flying autonomously several minutes ahead of the ground track flown by the planned Landsat 7 satellite, to provide accurate paired-scene comparisons between the new and the traditional observing technologies. Evolutionary versions of the Advanced Land Imager would be candidates for flight on future generations of NASA Earth Observing System missions, beginning with the AM-2 spacecraft.

Formally started in NASA's FY 1996 budget, the goal of the New Millennium program is to identify, develop, and flight-validate key instrument and spacecraft technologiesthat can enable new or more cost-effective approaches to conducting science missions in the 21st century. The overall program is managed by the Jet Propulsion Laboratory,

Pasadena, Calif., for NASA's Office of Space Science, Office of Space Access and Technology, and Office of Mission to Planet Earth, Washington, D.C.

The American Red Cross will accept blood donations on June 5, 1996, from 8:30 a.m. – 2:15 p.m. in the building 8 auditorium. To schedule a donation appointment, please call Janice Gelder at 6-5025 by 2 p.m. on June 4. To call the Bloodmobile directly on June 5, please call 6-7180. Please note that the number of appointments the Red Cross has is used to determine the American Red Cross' nursing staff.

Goddard News
National Aeronautics and Space Administration
Goddard Space Flight Center
NASA

The GODDARD NEWS is published monthly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

Recipients of 1996 Secretarial Awards

113	Patricia Lowery
114	LaShonda Goodwyn
130	Melinda Deyarmin
130	Elizabeth Flowers
152	Christopher Ridenour
201	Desiree Taminelli
202	Tiffany Thornton
210	Malores Ross
217	Trina Haffelfinger
220	Kathleen Reardon
233	Regina Waters
234	Gail Allen
253	Suzanne Goldberg
313	Deborah Schmitt
430	Kahtryn Hanlon
441	Virginia Beard
490	Kathryn Dinsmore
500	Sandra Camacho
504	Joan Tarkington
511	Linda Garufi
513	Maria Westman
603	Christine Baxley
690	Charlene Malloy
734	Darlene Mayo
750	Talaya Brooks
750	Donna Lynch
800	Gracie Drew
800	Karen Kleckner
920	P. Jeanine Doherty
920	Diana Elbert
979	Michele Gover

Deadline to submit material is the first of each month. For additional information contact Ernie Shannon (301) 286-8955.
The GODDARD NEWS Staff is:
Executive Editor: Jim Sahli
Acting Managing Editor: Ernie J. Shannon
Contributing Editors: Donna Drelick, Tammy Jones, W. Allen Kenitzer

National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

June 1996 Vol. 43 No. 16

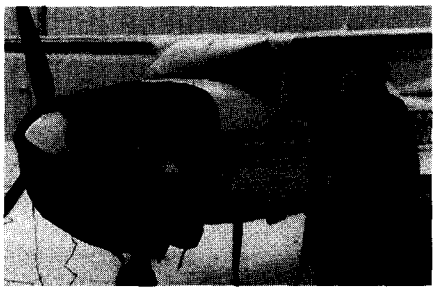
INSIDE

Goddard News
2
Polar Imagery Begins
3
New Options for Retiring Employees
5
TOMS-EP Planned for June
6
Chemical Measurements of Comet Hyakutake Suggest a New Class of Comets
7
Celebrate Goddard Day Set for July 12

Piers Sellers Picked for Astronaut Corps

By Ernie J. Shannon

Live images of Astronaut Neil Armstrong stepping onto the moon, beamed to the earth, set the course of a young British boy's life. Today, he prepares to enter that same astronaut corps.



Piers Sellers in Northern Canada at -40°C.

"I was mesmerized by the experience of watching Armstrong walk on the moon and I knew then that I wanted to someday travel to space myself," said Piers Sellers, a member of NASA's newest astronaut class and a scientist in the Laboratory for Terrestrial Physics at Goddard. Sellers reports to the Johnson Space Center in Houston in August.

It's common to hear American astronauts credit the historic Apollo missions as the inspiration for their dreams. One forgets, however, that many people around the world were inspired by America's achievements and also dreamed of going into space.

Sellers was born in southern England and raised around the world while his father filled assignments to British army posts in Cyprus, Malta, the Middle East and Europe. During those years, Sellers developed a love for flying while being trained by the Royal Air Force at school. The stark reality of a 16-year commitment to the Royal Air Force to pursue a fast jet flying career prevented him from signing on the dotted line for a commission. During those years, he also earned a degree in ecology and a Ph. D in bio-meterology. With the degrees in hand, pilot experience and one year serving as a software consultant in London, Sellers and his wife left England in 1982 and came to Maryland where he had been recruited by Goddard's Yale Mintz.

"Yale knew of my work in England and he was looking for people to do climate modeling and so we came into contact with each other. My wife and I arrived arrived in the U.S. for the first time with $60 in our pockets and three suit cases and I started work at Goddard two days later."

Beginning in 1984, Sellers began applying to the astronaut corps. The biggest obstacle was his lack of citizenship. He was finally naturalized in 1991. Still, he persisted in completing the paperwork each year if, for nothing else than to keep his name before the selection board.

By 1995, Sellers had already been down to Houston one year for the astronaut interviews, but this year was different.

"I could sense that things were more serious this time around. I was more apprehensive. What with nearly a week of medical tests combined with an intensive 40-minute interview with a panel that consisted of former astronaut John Young and some current astronauts," Sellers said. One hundred and twenty individuals interviewed for 35 slots, but Sellers knew the corps was seriously interested when a

Continued on Page 7

Hubble Tool Engineer Gets *The Call*

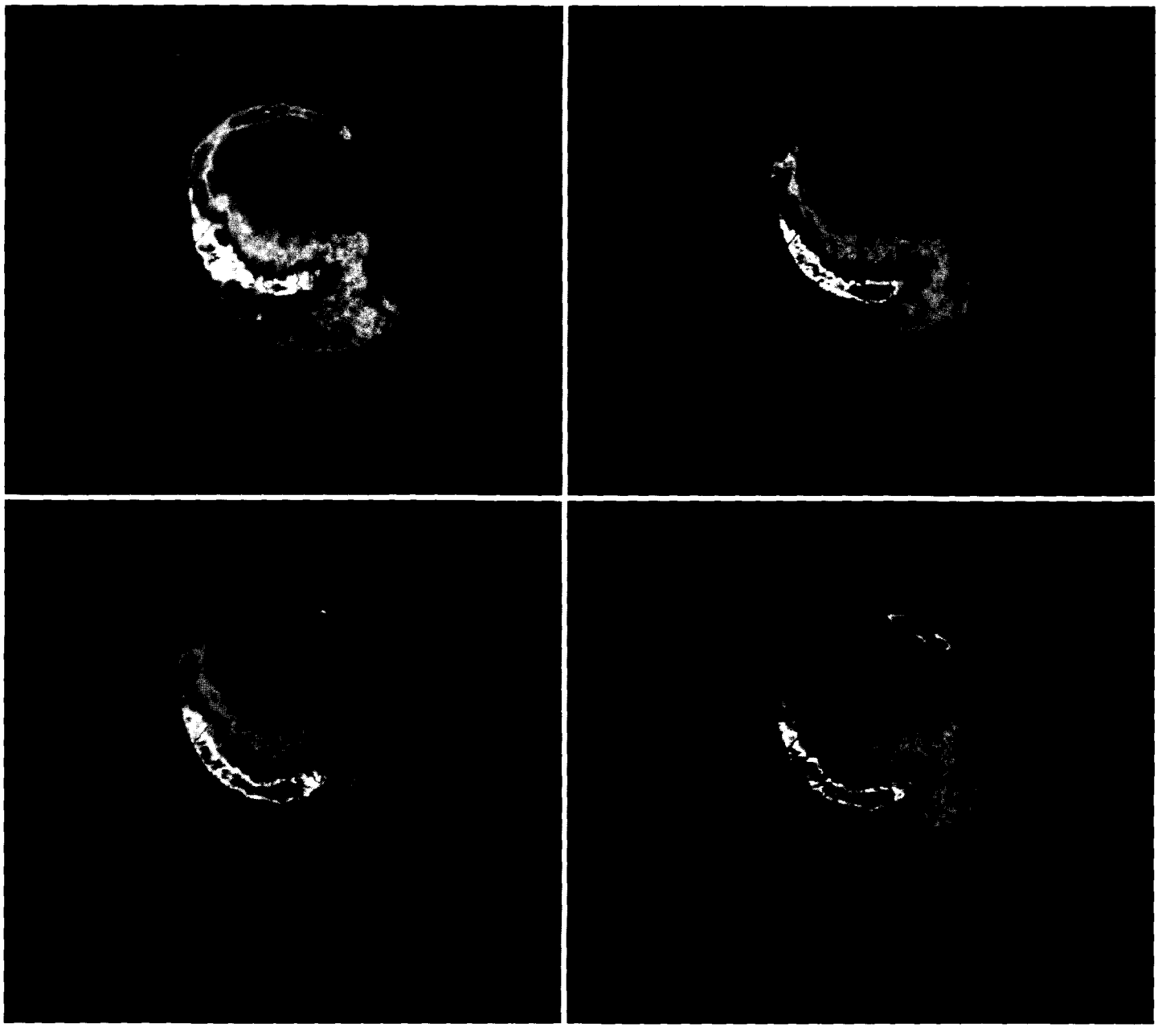
by Ann Jenkins

On April 29, Paul Richards of the Hubble Space Telescope Project finally got *The Call* from Houston. After years of applying and months of waiting for word, Hubble's "Tool Guy" was invited to join NASA's elite astronaut corps.

The EVA tool development engineer describes the weeks leading up to that call as maddening. Enthusiastic co-workers constantly asked, "Have you heard yet?" "It was a little frustrating," Richards admits. "I probably got asked at least ten, sometimes twenty times a day!"

Goddard engineer Paul Richards, shown here during a neutral buoyancy test for the Hubble Space Telescope Project at MSPC, has been chosen to become an astronaut.

Continued on Page 8



NASA Spacecraft Images

Polar Spacecraft Imagery Begins

Independence of Daylight and Nightside Aurora Observed — This four-image sequence taken over a 47-minute period on April 9, 1996, shows the dynamics of the dayside aurora and the onset of an auroral substorm with very intense nightside activity. It illustrates the remarkable capability and the types of auroral activity that have been observed already by the UltraViolet Imager on the Goddard-managed Polar spacecraft.

Upper left: (0 minutes) The dayside portion of the auroral oval over Canada is very active whereas the nightside oval along the Siberian coastline is relatively quiet.

Right top: (40 minutes) Changes in the dayside activity can be seen by comparison of the shape of the active region in this image.

Lower left: (42 minutes) A sudden brightening of the nightside aurora seen at the top of the figure is the first sign of the onset of an auroral substorm.

Bottom right: (47 minutes) The nightside activity has intensified greatly and spread in all directions over a five-minute period.

New Options Available for Retiring Employees

Employees eligible for retirement now have more options to consider when planning their future.

Because retirement is often a difficult decision, the Goddard Center has developed the "New Alternatives" program to provide attractive, voluntary incentives to help employees transition into retirement. The program is designed to give employees new alternatives, more control and greater flexibilities as they make retirement decisions.

What are the "new alternatives" options and how do they work?

Goddard is initially offering two new retirement options: Trial Retirement and Phased Retirement. These options are only available to permanent Goddard employees who volunteer for "early out" or optional retirement. Prior to entering the New Alternatives Retirement Transition Program, the employee signs a written agreement which specifies the conditions of their individual arrangement.

Trial Retirement

(offer expires Sept. 3, 1996)

Trial Retirement lets the employee "try out" retirement for 12 to 18 months. After 12 months, but no later than 18 months, if they decide retirement is not for them, Goddard will hire that person back as a re-employed annuitant at their former grade, unless they retired from a position with a grade higher than GS-15. These employees will be re-employed at the GS-15 level. Re-employed annuitants will perform duties similar to those performed while previously employed. Employees may decide to work either full-time or part-time. As a re-employed annuitant, they will continue to receive a retirement annuity while also earning a supplemental salary.

Phased Retirement

(offers expires Sept. 3, 1996)

Phased Retirement allows persons to transition into retirement. After the employee voluntarily retires from the civil service, they will be hired (as early as the next business day) as a re-employed annuitant. The employee will continue to receive a retirement annuity while also earning a supplementary salary that is pro-rated according to the number of hours they work. Phased Retirement affords employees three choices. They may submit a proposal to continue working in their current organization performing the same or similar duties, or they may submit a proposal to work in their current or a different organization performing a new line of work. These two choices provide the employee the opportunity to identify and propose a set of duties to perform. The last choice provides persons the opportunity to respond to a listing of work assignments designed especially for retirees. The Center will make this listing available in the near future. Employees who are considering Phased Retirement are encouraged to take this opportunity to pursue an area of personal interest.

All of the Phased Retirement choices described above permit Goddard people to work up to 1,040 hours a year for up to two years, working either part-time or full-time until they reach the 1,040 hour yearly limit. The organization in which they want to work and the Office of Human Resources must approve their work assignments and work schedule before their Phased Retirement is effected.

For general information on Trial or Phased retirement, call Donna Swann at 6-2172 or Tonya West at 6-5327. If employees have specific questions involving their personal retirement options or would like detailed retirement calculations, call Janet Morgan at 6-4709 to set up an individual retirement counseling appointment.

In addition to the Trial and Phased Retirement options described in this announcement, the Center is exploring additional opportunities to partner with retirees in commercial applications of new technology and in educational outreach endeavors, including in-classroom teaching assignments. Additional information will be publicized in coming weeks as soon as it is fully developed.

Beyond the Bottom Line

Editor's Note: The following article is taken from the September 1995 editor of Government Executive.

One of the great misconceptions about re-engineering is that it applies only to businesses, and large businesses at that. But re-engineering is not primarily about profit and loss, stock price or any other appurtenances of modern capitalism. It is about work. Re-engineering is concerned with the redesign of work so that it can be performed in a far superior way. Therefore, re-engineering is relevant for any organization in which work takes place: large or small, manufacturing or service, profit or non-profit, private or public sector.

It's true that when corporations re-engineer, they do so for financial benefits. But while Protagoras may have been right in saying that man is the measure of all things, money is not the measure of all organizations.

Think of the U.S. Army, Planned Parenthood, the Metropolitan Museum of Art, the American Civil Liberties Union, the John Birch Society. They certainly need money, often plenty of it, to pay their staffs, buy equipment, cover their rent. But to them, money is a means to a non-economic end. Their purposes transcend economics. We call these mission-driven organizations.

There are tens of thousands of them: government agencies, charities, hospitals, universities, schools, think-tanks, benevolent societies, veterans associations, communities of bird watchers. While improving their financial situation may be important, what really motivates them is performing their mission more effectively. Such institutions often consider finance a necessary evil, not to be confused with their fundamental mission, which usually seeks to improve or even transform lives.

Still, reengineering has much to offer these organizations, and some—the Army and the Social Security Administration, to name just two—have embarked on the adventure and are reaping its benefits. Reengineering is not just a capitalist tool. It enables any organization—those in the service of ideals as well as stockholders—to re-think its processes and find breakthrough ways of improving them. And although there are fewer reengineering tales to tell about the mission-driven world, where it has arrived more recently than in

Continued on Page 6

NASA's Hubble Space Telescope Probes Crab

By Tammy Jones

Probing the mysterious heart of the Crab Nebula, the tattered remains of a stellar cataclysm witnessed more than 900 years ago, astronomers using NASA's Hubble Space Telescope have found that the Crab is even more dynamic than previously understood, based on a cosmic "movie" assembled from a series of Hubble observations.

The results promise to shed new light on a variety of high energy phenomena in the universe, from nearby neutron stars to remote quasars.

Though changes in most astronomical objects are barely perceptible over a human lifetime, Hubble shows that the interior of the nebula "changes its stripes" every few days, according to Jeff Hester of Arizona State University, Tempe, Ariz., who leads the team of astronomers that took the images, which were separated by only a few weeks.

"We took the images a few weeks apart because we knew that it might be possible to observe slight differences in the Crab over a short time," said Hester. "But, I don't think that any of us were prepared for what we saw."

Though ground-based images of the Crab had shown subtle changes in the nebula over months or years, the Hubble movie shows sharp wisp-like features streaming away from the center of the nebula at half the speed of light.

The powerhouse at the center of the nebula responsible for these changes is a rapidly spinning neutron star — the compact core of the exploded star. Only about six miles (10 kilometers) across, the neutron star would fit inside a small town, "yet its small size belies its significance and the punch that it packs," Hester said.

As the neutron star spins on its axis 30 times a second its twin searchlight beams sweep past the Earth, causing the neutron star to blink on and off. Because of this flickering, the neutron star also is called a "pulsar." In addition to the pulses, the neutron star's rapid rotation and intense magnetic field act as an immense slingshot, accelerating subatomic particles to close to the speed of light and flinging them off into space.

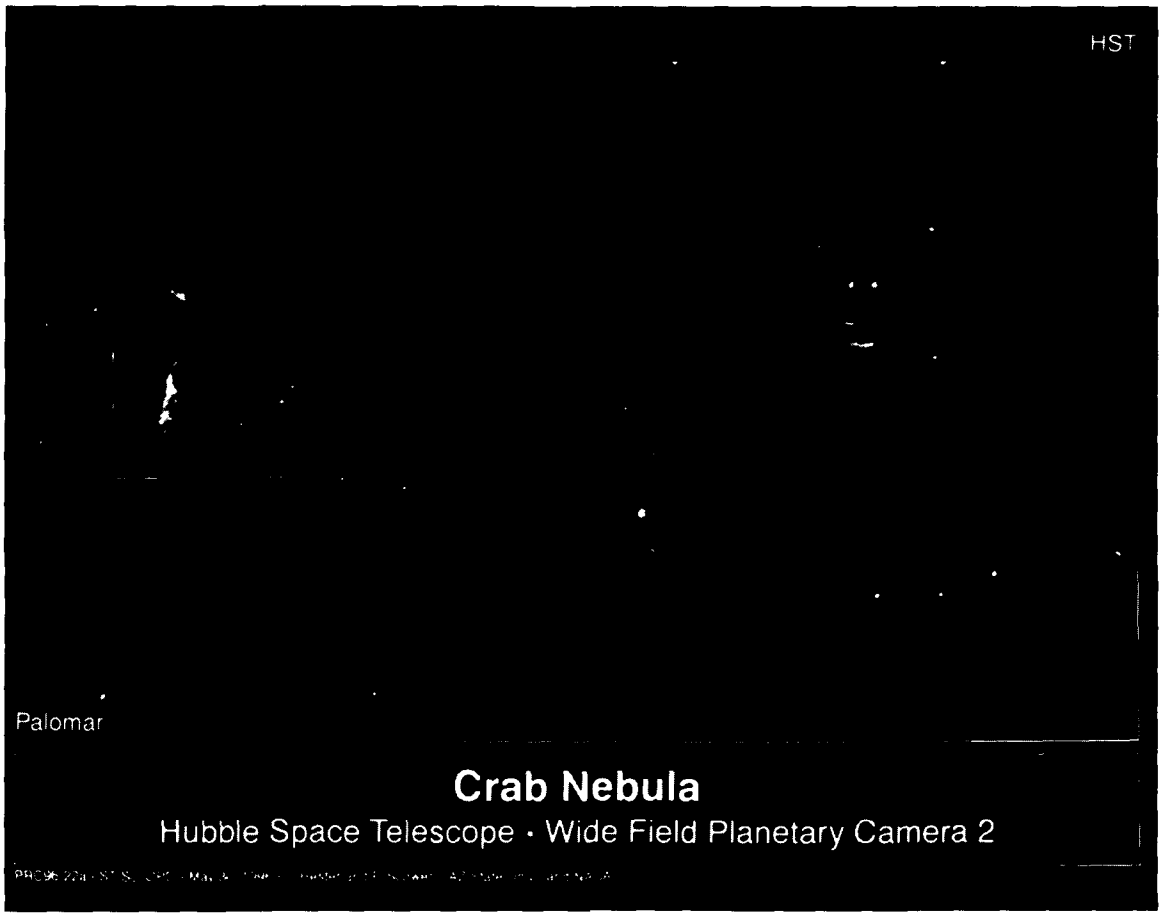
In a dramatic series of images assembled over several months of observation, Hubble shows what happens as this magnetic pulsar "wind" runs into the body of the Crab Nebula. The glowing, eerie shifting patterns of light in the center of the Crab are created by electrons and positrons (anti-matter electrons) as they spiral around magnetic field lines and radiate away energy. This lights up the interior volume of the nebula, which is more than ten light years across.

The Hubble team finds that material doesn't move away from the pulsar in all directions, but instead is concentrated into two polar "jets" and a wind moving out from the star's equator.

The most dynamic feature in the inner part of the Crab is the point where one of the polar jets runs into the surrounding material forming a shock front. The shape and position of this feature shifts about so rapidly that the astronomers describe it as a "dancing sprite," or "a cat on a hot plate." The equatorial wind appears as a series of wisp-like features that steepen, brighten, then fade as they move away from the pulsar to well out into the main body of the nebula.

"Watching the wisps move outward through the nebula is a lot like watching waves crashing on the beach — except that in the Crab the waves are a light year long and are moving through space at half the speed of light," said Hester. "You don't learn about ocean waves by staring at a snapshot. By their nature waves on the ocean are ever-

Continued on Page 8



Crab Nebula

Hubble Space Telescope · Wide Field Planetary Camera 2

TOMS Satellite Scheduled to Launch End of June

The Goddard-managed Total Ozone Mapping Spectrometer is projected for launch the end of June onboard an Earth Probe Satellite (TOMS/EP). The spacecraft is scheduled to be placed into orbit after deployment from a Pegasus rocket. A L-1011 will depart It will continue NASA's long term daily mapping of the global distribution of the Earth's atmospheric ozone.

TOMS/EP will take high-resolution measurements of the total column amount of ozone from space that began with NASA's Nimbus-7 satellite in 1978 and continued with the TOMS aboard a Russian Meteor-3 satellite until the instrument stopped working in December 1994. This NASA-developed instrument, measures ozone indirectly by mapping ultraviolet light emitted by the Sun to that scattered from the Earth's atmosphere back to the satellite. The TOMS instrument has mapped in detail the global ozone distribution as well as the Antarctic "ozone hole," which forms September through November of each year.

In addition to ozone, TOMS measures sulfur-dioxide released in volcanic eruptions. The U.S. Federal Aviation Administration (FAA) is studying ways to use these measurements to detect volcanic ash clouds that are hazardous to commercial aviation.

Ozone, a molecule made up of three oxygen atoms, shields life on Earth from the harmful effects of the ultraviolet radiation of the Sun. The increased amounts of ultraviolet radiation that would reach the Earth's surface because of ozone depletion could increase the incidence of skin cancer and cataracts in humans, harm crops and interfere with marine life.

Goddard Hosts First Community Outreach Fair

By Nina Desmond

"Join Together to Lend a Hand" was the theme of Goddard's first Community Outreach Fair, held on May 21. Over 100 Goddard employees came out to talk to several dozen volunteer coordin-ators from a variety of public and private community service organizations.

The purpose of the fair was to promote volun-teerism and provide employees an opportunity to discuss various community service options available in their com-munities. Many employees came to look for volunteer opportunities for their school age children. The school systems now are requiring students to participate in community service.

Some Goddard employees not only were attendees at the Outreach Fair, but also representatives of volunteer organizations. Ron Zaleski, offers computer assistance to the Frances R. Fuchs Special Center for physically and mentally challenged youngsters. The Fuchs Center is located just four miles from Goddard; Zaleski helps out by repairing personal computers and installing software. If you'd like to 'lend him a hand', please call 6-8449.

Three Goddard employees, Candice Carlisle, Dave Campbell, and Theresa Held are actively involved with Fidos for Freedom, an assistance dog training organization. This group trains and places dogs with mobility, deaf or hearing impaired individuals in the Washington- Baltimore metropolitan area. Fidos for Freedom also provide therapy dog visits to local health care facilities.

Some of the other service organizations participating in the fair included: Doc-tor's Community Hospital, Food & Friends, Jewish Council for the Aging, PG Memorial Library, Greenbelt Cares, Goddard's Visitor Center, Bowie SPCA, Whitman-Walker Clinic of Suburban Maryland, and the Red Cross.

In case you were unable to attend the fair, a summary of all the participating volunteer organiza-tions is available by calling 6-8141 in the Office of Public Affairs. The summary also can be accessed on Goddard's Homepage under the Public Services section. The URL address is http://pao.gsfc.nasa.gov/

Hyakutake Measurements Suggest New Class of Comets

Astronomers observing the close approach of Comet Hyakutake to the Earth in March discovered large quantities of the gases ethane and methane in the comet. This is the first time these or other molecules classified as "saturated hydrocarbons" have been found in a comet, strongly suggesting that at least two basic types of comets inhabit the Solar System. This conclusion also has potentially profound implications for scientific theories that describe the primordial conditions that led to the formation of the Sun and the planets.

The discovery was by a team of NASA and university researchers using the NASA Infrared Telescope Facility at Mauna Kea, Hawaii.

Ethane has never before been detected in comets or in interstellar matter, the ultimate source material from which the Solar System was formed. Yet, comet investigators found levels of ethane in Comet Hyakutake that are about 1,000 times greater than can be explained if the molecules were formed by normal physical processes within the gases of the primordial solar nebula, the birth cloud of the Solar System.

"The discovery of ethane was a blinding surprise," according to research team leader Dr. Michael J. Mumma of the Laboratory for Extraterrestrial Physics at Goddard. The spectral lines, or identifying signature of ethane gas, "were so bright they seemed to leap off the computer screen when we got the first observation," Mumma said.

The discoveries were made on March 24, 1996, with the three-meter diameter telescope of the NASA Infrared Telescope Facility atop Mauna Kea. The investigators used a state-of-the-art instrument known as a high-resolution infrared spectrometer. The device was cooled to about minus 400 degrees Fahrenheit to achieve the needed sensitivity to infrared light, which has a longer wavelength than red light and cannot be seen with the human eye.

The unexpected ethane discovery came as the observers searched for evidence of molecules of methyl alcohol, a known constituent of other comets. However, "the emissions of methyl alcohol that we first looked at were much weaker than expected, so we decided to search for other signatures of the alcohol," said research team member Dr. Michael A. DiSanti of the Catholic University of America, Washington, D.C. "But after reprogramming the spectrometer, instead of detecting methyl alcohol, we discovered ethane."

Further observations and analysis showed that ethane and methane each constitute about one percent of the frozen gases in Comet Hyakutake. (The astronomers measured radiation from gases released from their frozen state as the solid nucleus —or "dirty iceball"—of the comet was warmed by the Sun.)

"Comets that are rich in ethane must have experienced very different conditions during their birth than comets that do not contain it," Mumma said. One theory is that ethane-rich comets formed in the warmer region near the primitive Saturn and Jupiter, while those without it formed farther away from the young Sun, near the primitive Uranus and Neptune.

Another possibility is that cometary ices formed even earlier, in different layers of the original interstellar gas and dust cloud that led to the solar nebula. An even more challenging concept is that the vast sphere of comets that are believed to surround the Solar System, called the Oort Cloud, may contain comets that formed from different solar nebula—that is, stars other than the Sun. Chemical and physical processes may have been at work in any scenario, altering the properties of the material that now makes up the comet's ice.

The discovery of ethane in Comet Hyakutake will spur scientists to go back and review measurements of other comets to see if unusual blips in their data contain hints of ethane. "For example, we're going to go back and look at Comet Halley data again," Mumma said. Similar measurements of Comet Hale-Bopp, which will pass closely by Earth in March and April 1997, are scheduled for June, he added.

As a comparison to comets, there are three major categories of asteroids. Some of the rocky bodies now considered to be asteroids may in fact be dead nuclei of short-period comets.

Both ethane and methane occur naturally on Earth and some other planets, and in certain meteorites, including the Murchison meteorite that fell on Australia in 1969.

Bottom Line

Continued from Page 3

the private sector, these tales are still worth examining. They demonstrate many similarities with profit-driven re engineering—and certain meaningful differences.

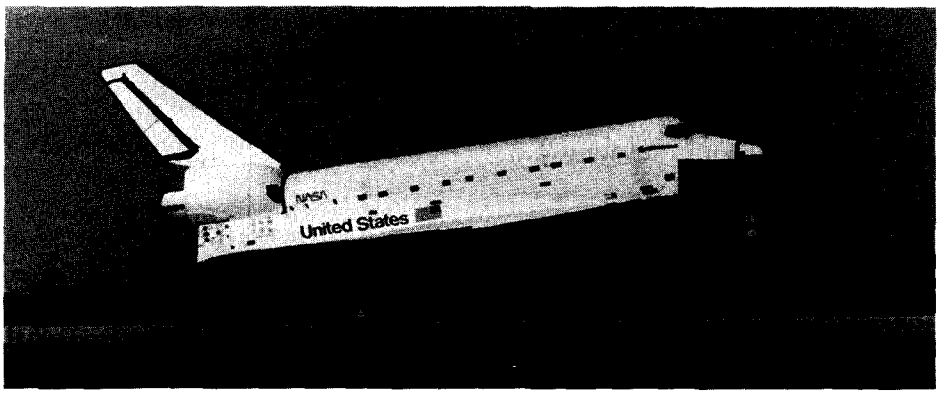
Defining Customers

There are two dilemmas inherent in virtually every mission-driven re engineering. The first is how to determine success. One of the great virtues of business is its relatively unambiguous way of judging results: the bottom line. It provides a clarity and precision that is almost always missing in a mission-driven environment.

A second problem facing mission-driven organizations contemplating re engineering involves identifying their customers. Before long, such organizations will almost inevitably find themselves involved in an agonizing debate about who, in fact, their customers are. Once again, most companies find this question relatively easy to answer: follow the money trail, as they say. But who is a college professor's customer? The student attending the class? The student's parents who are footing the bill? The employer who will eventually hire the student" The worldwide community of scholars, or mankind as a whole? An argument can be made in support of any of these alternatives. This ambiguity exists in virtually all mission-driven environments.

Since re-engineering must begin by identifying one's customers, determining their needs and deciding the best way to satisfy them, this is no academic question. It must be resolved and it isn't easy.

Given these considerations, it's not surprising that the first mission-driven organizations to reengineer have been most businesslike in the sense of having well-defined customers and performance measures expressible in financial terms. Across North America, the first governmental organizations to reengineer have mostly been the tax collectors, from the Ontario Ministry of Revenue to the IRS. Having defined the taxpayers as their customers—never mind that they are active ones—they are trying to make their process customer- and service-oriented. A belief that making it easier to pay the right amount of tax will increase tax compliance and tax revenues underlies this effort. Since revenue departments have an "income" line—the amount of tax collected—as well as the cost line, it is possible to compute their "profit" and the financial improvements wrought by reengineering.



The Orbiter Endeavor (OV-15) returns to Florida following a ten-day stay in space. Main gear touchdown on Runway 33 of KSC's Shuttle Landing Facility occurred at 7:09:18 a.m. EDT, May 29. On board Endeavour for Mission STS-77 are Commander John H. Casper; Pilot Curtis L. Brown Jr.; and Mission Specialists Andrew S. W. Thomas, Daniel W. Bursch, Mario Runco Jr. and Marc Garneau, who represents the Canadian Space Agency. Among the payloads the crew worked with were the SPACEHAB-4 module, fillled with a variety of microgravity research experiments; the Goddard-managed Spartan-207 deployable carrier which held the Inflatable Antenna Experiment (IAE) that was deployed during the flight Get Away Special Experiments; and the Technology Experiments for Advancing Missions in Space (TEAMS), a suite of four experiments. The highly successful mission marks Endeavour's last flight in space for some time to come.

Celebrate Goddard Day - A Multi-Cultural Festival

The Center's Multi-Cultural Advisory Team, in cooperation with Goddard diversity groups, organizations, GEWA clubs and other interested individuals is hosting the center's first "Celebrate Goddard Day - A Multicultural Festival," for Goddard employees and their families. This event will be held July 12, on the mall in front of Bldg. 3.

The purpose of this festival is to celebrate and appreciate the diversity, talents and unique abilities of the Goddard community. The celebration will include the sharing and experiencing of the many cultures. Goddard employees and their families, near-site contractors, officials from NASA Headquarters and local dignitaries have been invited.

For more information, contact the event co-chairs, Sandra Irish at 6-8944 or Sheri Thorton at 6-1104.

NASA Scholarship

By Tammy Jones

The NASA College Scholarship Fund has selected a Goddard employee's son to receive one of five college scholarship grants. Eric H. C. Liu of Ellicott City, Md., is the son of Anthony An-kou Liu.

Liu will pursue a career in engineering at Stanford University this fall. He is a graduate of Centennial High School in Ellicott City. He graduated as the top student in his class of 324 and received a score of 1510 on the SAT. Liu received straight A's throughout high school, including nine advanced placement gifted and talented courses in math and science.

More than 100 students applied for the five available $2,000 scholarships. The scholarships were awarded for the student's high level of academic achievements and personal accomplishments. Each scholarship will be renewable annually for a maximum of $8,000 over six calendar years.

The fund was established to award scholarships agency-wide to qualified dependents of NASA and former NASA employees. The fund was a direct result of a substantial unsolicited gift by the noted Pulitzer Prize winning author, James A. Michener.

Many NASA employees have contributed to the fund directly or through the Combined Federal Campaign. Other major contributors include the Freedom Forum (to honor the Hubble Space Telescope crew members) and the Johnson Space Center chapter of the NASA Alumni League.

Sellers

Continued from Page 1

representative of the Office of Personnel Management interviewed him here. "They checked out friends, neighbors and relatives."

An announcement had been expected in March, April rolled around with no news. In late April, Sellers departed for a trip to Canada to perform studies in the Boreas experiment flying an instrumented aircraft among other things. During his return trip, he was transferring planes in the Minneapolis airport when the public address announcer broadcast a phone call waiting for Sellers. He had been told previously that if the call came from anyone other than the chief of astronauts, Bob Cabana, he would know he had failed to make the selection. Thus, when the call came, it was from another individual at Johnson, not Cabana.

"My heart sank and as I walked to the phone I began thinking what I would say, preparing myself for the disappointment." However, upon taking the phone, the caller asked Sellers to hold for Bob Cabana...and the rest is history.

"I went from great disappointment to exhilaration in an instant," Sellers explained.

After reporting in August, Sellers will spend his first year in Houston in training. Toward the end of that period, Sellers will be assigned to a specialty area in which he will undergo at least another year of technical training in preparation for an assignment to a Space Shuttle mission.

Sellers enters astronaut training in a particularly exciting time when the corps is preparing for the momentous international space station construction as well as service aboard the Russian space station Mir. NASA will be as busy as it has ever been in space during this period and Sellers figures to be in the middle of it.

Hubble

Continued from Page 1

Even when the call came, Houston played a little joke.

Richards explains, "I was called by Bob Cabana [Chief of the Astronaut Office]. I was paged, actually. I came into my office, returned the page and was put on hold for about twenty seconds. Then Bob Cabana answered, and initially I thought: *Great news! He's the head of the Astronaut Office, he should be one of the guys calling.* He said that I'd probably heard through the grapevine that they are notifying candidates today. Unfortunately, he said, 'Dave Leestma usually calls the people who made it.' Because he is speaking to me, the news isn't as good. I just got very silent. Then he said: 'No, just pulling your leg! How would you like to come down and build Space Station for us?'"

Although co-workers never doubted he'd make it, Richards says he is pleasantly surprised. "The average age is 37; I'm 31. And seeing that a lot of the astronauts I work with went through two, three, some even four interviews before being selected, I thought that this was going to be the beginning of a longer process."

The first call Paul made was to his mother. "She said she was proud, and that my father would be proud—that he had probably been looking down on me for the last ten years.

Richards' selection is the fulfillment of a promise as well as a dream. As a boy growing up in Dunmore, Pa., he often spoke to his father about his desire to become an astronaut. His dream continued beyond grade school and high school and into college. In his senior year at Drexel, his father became terminally ill and Richards left school to take care of him.

"I promised him that within two years I'd be working with NASA, within five years I'd have my master's degree, and within ten years I'd be an astronaut." Though his dad didn't live to see him graduate from college, Richards held true to that schedule.

"So, now I'm wrapping up the work here," Richards says of his current job with Hubble Space Telescope. "I've had a really good team, and they're taking up the slack of me leaving. But, I have to wrap things up and make sure they're on their way and get good closure."

On Aug. 12, Richards will report to Johnson Space Center in Houston to begin an intense period of astronaut training. "We'll start off with orientation, and throughout the year we'll learn about all the NASA centers," explains Richards. "We'll get fitted for our flight suits, helmets, boots and we'll do survival training. We'll start learning about the Shuttle and its capabilities and systems, from the software to the hydraulics, to the Remote Manipulator System. We'll also get introduced to EVA [extravehicular activity] in a space suit and we'll get all the general training and the general knowledge base that one needs to fly in space." After that training, he will transition from astronaut candidate to astronaut and await a flight assignment.

This year's astronaut candidate class is the 16th since the first class of Mercury test pilots was selected in 1959. From last year's original pool of 2,432 applicants, Richards was one of only 35 astronaut candidates selected.

Richards' astronaut adventures will likely include using the tools he helped develop. If all works out, he may even be considered for the Hubble Space Telescope Third Servicing Mission, scheduled for 1999.

"It's going to be sad for me to leave Goddard," Richards confides. "I've come to admire and respect all the people here. I feel that without having been a Goddard employee—given the opportunities that I've had all the way up from testing to mechanisms design to robotics to the Hubble program—I wouldn't have been selected. Having the opportunity at Goddard to be a hands-on engineer—and to actually BE an engineer instead of a manager—that's what got me the job!—I'd like to thank everybody that I've worked with and for along the way."

Crab Nebula

Continued from Page 4

changing. You learn about ocean waves by sitting on the beach and watching as they roll ashore. This Hubble 'movie' of the Crab is so significant because for the first time we are watching as these 'waves' from the Crab come rolling in."

The Crab Nebula, the result of a supernova explosion witnessed by Chinese astronomers in 1054 AD, also is widely studied because it offers a unique opportunity to study high energy astrophysical phenomena. The physical processes that are at work in the centers of distant active galaxies and quasars are thought to be much like the processes at work in the center of the Crab, only on a vastly larger scale. "The difference is that while astronomers may never truly 'see' into the very heart of an active galaxy, the Crab allows the properties and behavior of high energy winds and jets to be studied up close and personal," Hester said.

"The Hubble results aren't the end of the story," Hester emphasized. "Rather, they are a piece of a larger puzzle.

Goddard News NASA

The GODDARD NEWS is published monthly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

Deadline to submit material is the first of each month. For additional information contact Ernie J. Shannon (301) 286-6256.

The GODDARD NEWS Staff is:

Executive Editor: Jim Sahli

Managing Editor: Ernie J. Shannon

Contributing Editors: Donna Drelick, Tammy Jones, W. Allen Kenitzer

National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

July 1996 Vol. 43 No. 17

INSIDE

Goddard News 2
NASA Aids Mongolian Firefighting 3
Earth Alert Technology at GSFC 6
Goddard Engineer Given AIAA Award

Pegasus/TOMS Launch Successful from Vandenberg AFB

The Goddard-managed Total Ozone Mapping Spectrometer Earth Probe (TOMS-EP) satellite was successfully launched July 2 aboard an Orbital Science Pegasus XL vehicle.

The launch occurred just after midnight at 12:48 PDT, putting TOMS-EP into an orbit of 517 statute miles. The satellite is expected to be fully operational by the end of July.

The successful launch means that high-resolution measurements of the total column amount of ozone from space will once again be available to scientists. The data flow, which began in 1978 with the launch of the Nimbus-7 satellite and continued with the start of the TOMS Meteor-3 mission, ended when Meteor-3 was deactivated in December 1994.

Initial checkout of the satellite and the spectrometer found only minor issues to work. Project Manager Phil Sabelhaus termed the launch and beginning stages of the flight as near perfect.

"We're in great shape and hope to have a fully operational instrument within a short time."

Goddard Team Develops Commercial Off-the-Shelf Ground System Prototype

In just 90 days, NASA's Goddard Space Flight Center integrated a prototype space flight ground support system using commercial off-the-shelf (COTS) software products. This accomplishment sets the stage for lower costs and shorter development time for future spacecraft ground systems.

Developed by a NASA-industry team, the "proof-of-concept" project called Integrated Monitoring, Analysis, and Control COTS System (IMACCS) is based 85 percent on commercially available computer products and 15 percent on government products, and has performed all functions successfully under stress of live mission data.

Development of the IMACCS was accomplished at about one-seventh the cost of a typical ground system using non-COTS products. This cost of the IMACCS implementation with no redundancy was $525,000, said Gary Meyers of Goddard's Mission Operations and Data Systems Directorate (MO&DSD).

"The success of this prototype opens the door for refining NASA's approach to ground system services. With IMACCS, we not only processed real data but actually commanded the Solar, Anomalous, and Magnetospheric Particle Explorer (SAMPEX) spacecraft. It clearly shows the potential to support Goddard's goals to deliver high-quality, highly-productive missions for our customers but more quickly and with less cost to the taxpayer," he said.

IMACCS demonstrates that developing a ground system in one year for mission customers is an achievable goal in the evolution from large missions to smaller single-purpose ones. IMACCS is one of several innovative, lower-cost initiatives Goddard is pursuing as alternatives to larger customized ground support systems.

"With a combination of COTS and Government-Off-The-Shelf (GOTS) products, IMACCS and products like it are key to substantial savings over development and operations items in future missions. Their high use of mature off-the-shelf products costs less in time, material, and labor," he said.

The IMACCS prototype is a collaboration between Goddard and industry. Goddard's MO&DSD implemented the COTS-based system with an industry team led by the Computer Sciences Corporation (CSC). CSC supported the integration of software and hardware products from Loral Test and Information Systems; Altair Aerospace Corporation; Analytical Graphics, Inc.; BBN Software Products Corporation; Storm Integration, Inc.; The MathWorks; and Talarian, Inc.

IMACCS Functional Capabilities

IMACCS meets the majority of ground system needs of a typical scientific spacecraft. Elements included in the IMACCS system cover health and safety

Continued on Page 8

Goddard Center Director Joe Rothenberg, left, and Associate Director for Mission to Planet Earth, Bob Price, second from left, meet with employees during a recent get together. Rothenberg and other senior managers are holding "get acquainted" sessions with employees throughout the center.

NASA Satellite Station Aids Fire Fighting

By Ernie J. Shannon

During a season in which fires have scorched more than 23 million acres of Mongolian forest and range lands, a NASA meteorological satellite receiving station is helping to save lives and livestock.

An exceptionally dry winter which saw little snowfall has given way to a hot and dry summer providing tinder for large forest fires across northern Mongolia. The conflagration has consumed 8.6 million acres of forests and 14.3 million acres of grasslands and has claimed 800 lives and 7,800 livestock. It could, however, have been much worse for man and beast.

In the midst of this record-setting fire season, Goddard researcher Dr. Compton J. Tucker, of the Earth Sciences Directorate, traveled to Ulaanbaatar, Mongolia in May, site of the satellite station, to monitor its operations. Because of the rapidly changing course and intensity of the fires, keeping the station in operation has become extremely important to the Mongolian firefighting effort. Tucker said the NASA-installed equipment has played a key role in fighting the fires.

"The meteorological satellite receiving station is invaluable for locating wild fires and tracking their movements," Tucker said. "Using several channels on the advanced very high resolution radiometer instrument aboard a National Oceanic and Atmospheric Administration (NOAA) satellite, wild fires can be identified and monitored."

According to the American Ambassador to Mongolia, Donald C. Johnson, the meterological station is providing the Mongolian National Emergency Commission with day-to-day reports on the fires' progress throughout the country. The near real-time information has allowed the commission to warn inhabitants, especially those with large herds, to move out of the paths of flames to safety.

Ambassador Johnson said that the Mongolian station employees rise each day at 2 or 3 a.m. to catch the first pass of the NOAA satellite. They then prepare a comprehensive report for the emergency commission pinpointing the location of fires, tracking the movement and giving early warning to government officials.

NASA provided the satellite receiving station to Mongolia through a Memorandum of Understanding agreement. In June 1995, Goddard hardware engineer Patrick Coronado and software engineers Gene Shaffer and Allan Lunsford, all of the Space Data and Computing Division in the Earth Sciences Directorate, installed a new antenna, image processing system and other equipment at the receiving station. In December, NASA and Mongolia extended the Memorandum of Understanding for an additional five years.

Ambassador Johnson, in a letter to NASA Administrator Dan Goldin, praised the work of Tucker and his associates and said, "I have made improved science cooperation with Mongolia one of the top priorities during my service here as ambassador. Contributions such as the NASA-provided station have enabled us to strengthen this bilateral cooperation in ways that are tangible and clearly understood by the 'average citizen."

Earth Alert Technology Demonstrated at Goddard

By Donna Drelick

Imagine that you are camping in a remote, desolate area. No electricity, no phones, no contact with civilization—just what the doctor ordered. But as luck would have it, fires have erupted in the forest surrounding your camp site. Because you are cut-off from communication, you have no way of knowing of this impending disaster. If only you had a portable device that could give you such information.

Such a system, called "Earth Alert" has been developed through a joint project by Goddard and the Scientific and Commercial Systems Corporation (SCSC), Beltsville, Md. The portable system designed to provide warning of disasters via a hand-held, pager like device was demonstrated at Goddard on July 2.

"We have shown that existing NASA technology can be used for humanitarian service while creating a niche for American industry," said Patrick Gary, of the Computer Networks & Communications Branch, one of the designers of the system.

Goddard engineers initially conceived and co-developed the warning system to broadcast survival information to isolated populations using old weather and communications satellites. The Office of Commercial Programs provided support for the project while SCSC provided labor and the manufacturing of the prototype.

Earth Alert manually enters and transmits information from weather satellite uplink stations to geostationary altitude where the satellite system rebroadcasts it back to Earth. A solar powered, pole-mounted communications repeater ground station then receives and broadcasts the message to personal receivers. The personal receivers produce an audio tone and a visual symbol message. The symbols communicate across language and literary barriers by illustrating hurricanes, floods, fire, and other disasters. The total time needed to broadcast the warning is 15 seconds.

"We envision numerous uses for Earth Alert," stated Janice Lee of SCSC. "We'd like to see this product get in the hands of everyone who can benefit from such a warning system. Fishermen, tourists on island resorts, campers, people who live near chemical plants. Wherever we could minimize a disaster before it happens."

Earth Alert will be tested with the Hawaii State Civil Defense Office later this summer, using the former GOES-2 weather

Continued on Page 5

Center Enters Refocusing Era

By Ernie J. Shannon

Goddard is changing. With a mandate formulated at the White House, reinforced on Capitol Hill and stamped with approval by NASA Administrator Dan Goldin, the agency and Goddard are refocusing the Center's mission and workforce.

No longer are faster, better and cheaper words used to orchestrate the latest total quality management program, they are happening at Goddard and promise to be the foundation upon which Goddard enters the next century.

In the middle of this maelstrom Center Director Joe Rothenberg moves easily, convinced of the rightness and necessity to "retool" Goddard and reset the course the organization and its more than 3,000 civil servants will tread during the next decade.

"We are restructuring ourselves at Goddard and it's about what we do and how we do it," Rothenberg says. "We must change the way we perform our responsibilities to allow us to meet the timeliness and costs envisioned by our administrator as well as the administration and Congress. I know that many people refer to the changes here as a 'reengineering' effort. However, that connotes radical change and that's not what we are about." Rather, Goddard is about refocusing the work in a common sensical manner that draws upon the best skills and capacities of the center's workforce. It's called "Project Goddard."

For several months, a group of employees have been working as a Strategic Planning Group. The group, chaired by Earth Science Directorate Deputy Director Dot Zukor and composed of representatives from all major center organizations, recently developed a mission statement or blueprint for Goddard. The statement, though not yet finalized, promises to outline the center's core business in the coming years as well as make a case for the change necessary to accomplish the work.

"As we restructure and emphasize certain areas while de-emphasizing others, it is my hope that the Strategic Plan will illuminate the future and provide motivation to bring projects to fruition quicker at a lot less cost while working with greater unity than ever before with the contracting world, academia and others," Rothenberg said.

Rothenberg says he is already seeing "buy in" to the changes from employees throughout the center, especially from younger employees excited by the challenges.

"Our challenge, believe it or not, is developing the same enthusiasm among management. We need the same enthusiasm and fire to bring about such programs as the Small Explorer effort. Small Explorer is just the beginning and it's about more science for lower costs...in other words, more science for the dollar."

Rothenberg is not flying by the seat of his pants in this era of change. Already, he foresees the day when Goddard can seal a spacecraft contract in a month. Such ideas as pre-qualifying subcontractors, putting spacecraft on a GSA list of sorts and holding mini-competitions for contracts are just a few of the ideas in their infancy here. There are many more.

"I can easily see Goddard employees working on innovative missions that occur in short periods of time that will be fun and scientifically challenging for our workforce. We'll bring our significant skills and experience to bear on projects that return large quantities of data to our science communities and to the nation at large," Rothenberg says.

The mandate for change is set in stone and the budgetary realities of today will force changes whether the center wants them or not. Goddard's challenge, and it's one Rothenberg readily accepts, is to proactively restructure the workforce and its skills to meet the changes before they arrive.

Integrated Product Development Teams— A New Way of Doing Business

by Donna Drelick

What do you get when a half-dozen engineering experts from competing industries and government lock themselves in a room for three hours in the desert southwest? In the case of the New Millennium program, designs for a lightweight Advanced Land Imaging Instrument and an exciting new way of doing business for Goddard.

Plans for the technologically advanced hyperspectral Land Imager Instrument, which will be the primary payload of the EO-1 mission of the New Millennium Program, were born on an October evening in a Sante Fe, N.M., condominium. The concept for the advanced scientific instrument materialized after a late night session of brainstorming by a small group of government and industry experts. The initial plans made on that autumn evening have since survived many levels of intense scrutiny.

"We learned that if you get the right industry experts together in a room, they collectively will produce a superior product," said Goddard's Bernard Seery, the co-lead on the Instrument Technologies and Architecture New Millennium Integrated Product Development Team. "We knew right from the start that we could put individual interests aside and contribute as a team to get the job done. The development of the Advanced Land Imager Instrument is an excellent example of ingenuity and teamwork working for a common cause."

Under Goddard project management, the Advanced Land Imager will be developed from instrument technologies proposed by members of the Integrated Product Development Team, which designed a road map that brings industry and government together to deliver breakthrough technologies.

The team of industry partners will be led by Don Lencioni of the Massachusetts Institute of Technology's Lincoln Laboratory, Lexington, Mass., a federally funded research and development center. In order to expedite the transfer of technology into the commercial sector, Lincoln Lab and its partners, SSG and Hughes, will provide open access to U.S. industry regarding the design and performance of the Advanced Land Imager.

The new multispectral/hyperspectral Land Imager instrument will demonstrate remote-sensing measurements of the Earth consistent with data collected since 1972 through Landsat. However, the new instrument will acquire data with finer resolution and will lay the groundwork for future land imaging instruments to be more compact and less costly.

The all silicon carbide Advanced Land Imager represents an approximate sevenfold decrease in mass and electrical power usage demands compared to the Landsat 7 multispectral instrument. The instrument also will extend the existing measurement capabilities by using an advanced high resolution "spectrometer-on-a-chip", which requires no scan mirror and is built around a novel wedge filter structure and high temperature infrared detector array.

The spacecraft support structure, including advanced electrical power and data-handling subsystems, will be provided by Swales & Associates, Inc., of Beltsville, and Litton Industries of College Park.

The goal of the New Millennium program is to identify, develop, and flight-validate key instrument and spacecraft technologies that will enable new and more cost effective approaches to conducting science missions in the 21st century. The launch of the first New Millennium Earth orbiting mission is planned for late 1998.

Using Editors When and Where it Counts

by Judith Goode, The Editorial Eye

Being asked to do too little too late is the common fate of technical editors. They often join the project team when document plans have long since been approved and writers are finishing their drafts.

Documentation managers in industry settings tend to assume that editing is value added at the end of the writing cycle. But early in the process is actually when a technical editor can be most helpful. Skillful editing can cut about 25 percent of excess from almost any technical document and improve what's left.

A technical document is any information developed by technical writers and editors for a specific audience: a user guide, a technical proposal, product specifications, online help, or the like.

A technical editor brought in at the 11th hour has to rely on the project manager for an evaluation of what needs to be done - and that evaluation may not be right. Even if the editor reviews the document and makes recommendations, the schedule and the budget probably no longer permit major changes. An editor confined to a quick pass for mechanical style and consistency can't save a flawed document even if it is sure to let users down.

In the technical divisions of major publishers like McGraw-Hill, a "developmental editor" is involved before writing begins. This editor works with the writer on shaping the document, acts as a sounding board, and influences decisions on structure and language. Here are ways editors can help technical documents:

Fewer words equal shorter documents: This formula may seem obvious, but in practice it's ignored. Technical documents typically have just too many words that add up to too many pages that add up to costly production time. One reason is that writers are asked to incorporate text from documents written by others: proposal boilerplate, companion-product descriptions, or instructions for using a new application.

Before the writer even sees this additional text, the documentation manager should give it to a technical editor for rigorous editing. The editor can note potential style problems, pare down the sheer number of words a writer will have to incorporate, and make it likelier that the final document will work as a coherent whole. Another reason to look closely at technical copy being cobbled together from several writers is inconsistent terminology. I was

Continued on Page 5

Home Page Sparks Comments Worldwide

Goddard Space Flight Center's homepage is getting reviews from around the country and even overseas as it continues to evolve. Following are some examples of the weekly comments collected in the Public Affairs Office:

"Thank you! Thank you! You cannot possibly imagine what it means to the 'little guys' to have access to such beautiful and awesome images as those generated by the HST. It makes me appreciate how small I am and also how we, the people of the Earth, are truly one together."

"I am student, study information and communication...I have many interest in Satellites...I will work for satellite communication...Actually, I don't know much about the Internet...and its system...and here the site is free of charge...Anyway, I am very glad to come here.

"What a great homepage! I like the layout too."

"I never got a chance to tell all of you at the National Aeronautics and Space Administration what a great job you are doing!!! Keep up the good work!! You are our future."

"Congratulations on a very well done page. I thought the Astro news page maintained by Sky and Telescope was great, but yours is something else. I happened upon it by chance. I think it should be advertised everywhere space buffs can hear about it."

"When I was younger, I was always interested in space. I never had the opportunity to study it the way I dreamed of. But thanks to the pictures and articles that are available to me through the Internet I feel like I am there. I just wanted to say 'thank you.'"

Technical Information Services Temporarily Relocated

The Technical Information Services Branch (Code 253) has temporarily relocated several of its services due to the HVAC renovation work being done in Bldg. 8. These service areas include the Service Center, Photography, Cost-per-Copy and Copy Management. Employees can still reach these staff members at their current phone numbers except Jane Semeraro and Jim Power, who can be reached at 220-1701.

The Service Center has been moved to room N-15 in Bldg. 8. Passport photos will be taken in the Bldg. 8 auditorium (2nd floor) when the facility is available. Call the Service Center at 6-3000 to schedule an appointment. Most staff members will be back in place by the end of August and the entire renovation should be completed by November.

Daedalus Enterprises Awarded NASA Phase II SBIR Contract

NASA has awarded Daedalus Enterprises, Inc., of Ann Arbor, Mich., a Phase II Small Business Innovation Research (SBIR) contract. The contract is entitled "Laser Search and Rescue" and has a value of $599,958.

Daedalus will design and build a new system with a day/night search capability. Using this instrument, a search mission will be able to quickly and accurately locate any specially marked components (hull or airframe fragments, life rafts, life jackets, etc.) of a downed aircraft or watercraft in distress.

This instrument has the potential to significantly reduce the search time between the occurrence of the accident and the determination of the accident location. This reduction in time will greatly increase the probability of survival for the occupants of the aircraft or watercraft. Daedalus has received support commitments from the Civil Air Patrol, the U.S. Coast Guard and two manufacturers of relative materials, Reflexite Corporation and 3M.

Since 1983, federal agencies with large research and development budgets have conducted SBIR programs to strengthen the role of small innovative firms in federally supported research and development. Daedalus has been active in the program since its inception and has received 18 Phase I and 11 Phase II awards.

Editors

Continued from Page 4

once asked to edit the final draft of a maintenance manual — all 600 pages of it. Right away, I found alarming inconsistencies. The writer mentioned that more than half of the draft had been written by someone in another group and he's simply downloaded those files into his document. When I pointed out that terminology for a procedure central to the book varied from chapter to chapter, he said, "I didn't have time to read the imported files."

The writer acknowledged the exhausting redundancies and inconsistencies I found and responded enthusiastically to my edits — until he realized that there wasn't time in the schedule to make all the changes online. He managed some primitive fixes, but the book went to press still weighing in at 600 pages.

Earth Alert

Continued from Page 3

satellite as a communication relay for the islands. Tsunami (seismic sea waves) warnings are severely needed by the State of Hawaii, and this device may prove to provide that warning system. Once the system has been tested, it will be ready for manufacturing. "Earth Alert is an excellent example of how NASA technology can be used for humanitarian efforts at a very low cost. I think this shows that NASA is a good world neighbor," said George Alcorn, Chief of the Commercial Programs Office.

Goddard Engineer Receives Premiere AIAA Award

by Donna Drelick

Glenn Lightsey claims that working on the Global Positioning System (GPS) is a once in a lifetime opportunity which makes him feel like a 'kid in a candy shop'. Well, that kid has received a sweet reward.

The American Institute of Aeronautics and Astronautics (AIAA) National Capital Section has presented Goddard's Glenn Lightsey with the Young Engineer/ Scientist Award. The premier award is presented to an AIAA member under the age of 36, for significant accomplishment and career leadership in aerospace and aeronautics.

"This is a tremendous honor," stated Lightsey. "Goddard has been great to me, and I am proud to represent the Center with this award." Lightsey has worked at Goddard since 1986, when he was hired "fresh-out" of Princeton. Since then, he has received a Master's Degree in Electrical Engineering from Johns Hopkins and is completing his Doctorate from Stanford University. These educational opportunities were a result of the Goddard Research and Study Fellowship Program.

"Goddard provided me with wonderful opportunities. Because of this, almost by providence, I found myself in the right place at the right time," said Lightsey.

While at Stanford, Lightsey was able to work with Brad Parkinson, a world expert in GPS. Although GPS was conceived in the 1970's, it took almost 20 years to make it operational. "All of a sudden, it was operational and I was working for someone who conceived it. I began designing and planning GPS on spacecraft and was able to bring this expertise back home to Goddard," said Lightsey.

The Global Positioning System is a constellation of 24 satellites in orbit that generate signals from which positions can be computed either on or above the Earth. Until recently, the system was used primarily by the military. Lightsey, however, took a basic ground receiver and changed the software to allow the receiver to work in space, thereby creating the capability of a spacecraft to track itself. The new capability means that a spacecraft is one step closer to autonomy.

As Lightsey is able to reach his potential, he feels that it is his responsibility to see GPS reach its potential.

Glenn Lightsey shown with his GPS hardware.

"This technology is far reaching and exciting. In the future, it could literally be on all spacecraft in low Earth orbit. Goddard is at the forefront of this technology and we feel that it is our job to lead the world in its development."

Lightsey is originally from Columbia, S.C., and makes his home now in Ellicott City with his wife, Jeannie, and their four month old son, Connor. Thus far, the young engineer says "life has been a wild ride."

Greenbelt Hams Gear Up to Set Long Distance Contract Records

Hundreds of local amateur radio operators, including a number of Goddard employees, worked around the clock for a weekend in late June setting up two-way radio communication stations, getting on the air and contacting thousands of other operators in the U.S. and Canada as part of the American Radio Relay League's (ARRL) Field Day.

According to Robert DiRosario, president of the Goddard Amateur Radio Club, Field Day is the annual "shakedown run" for the ARRL's national field organization.

"Field Day is a way for hams to get outdoors and have fun under some difficult conditions," DiRosario says. "But it's also a chance to fine-tune emergency communication skills. We use generator and battery power, and we set up antennas in the field. The idea is to put together a self-sufficient, working station quickly and begin making contacts."

Government Computer News Honors 2 at Goddard

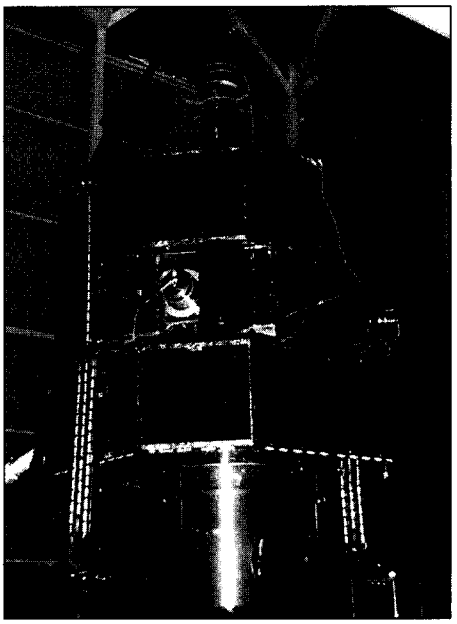
Government Computer News recently honored two Goddard employees with awards for their hardware and software contributions to education.

Fritz Hasler of the Laboratory for Atmospheres and Ed Masuoka of the Laboratory for Terrestrial Physics received awards during a luncheon at the National Press Club in Washington, D.C.

Continued next column

The computer organization honored Hasler for his efforts to make remote sensing data available to students K through 12 and beyond. According to the award nomination committee, "Hasler has been instrumental in making NASA remote sensing data appealing to students and the general public and getting visualizations out to them via network television, the print media and the Internet. He has accomplished this through innovative cooperative efforts with universities, private companies, the American Meteorological Society, the Smithsonian Institute, other NASA centers, NOAA and the White House."

Masuoka, who heads the Computing Systems Office, was honored for his management of the Moderate Resolution Imaging Specroradiometer (MODIS), a key Earth Observation System instrument. The nominating committee said, "Developing software and integrating a computing system to support the MODIS instrument have been a major challenge that Masuoka has successfully undertaken. The result of his effort will improve the future of information technology in the area of remote sensing."



Shown here is the Goddard-managed Fast Auroral Snapshot (FAST) Explorer as it sits in a cleanroom in Building 7 at Goddard Center just prior to shipment. FAST departed Goddard for its Vandenberg AFB launch site in California June 21. Launch for the space science department is currently set for Aug. 16 from a Pegasus XL rocket.

About 250 people attended the recent Asian/Pacific American Heritage Day celebration at Goddard. Among those welcoming the audience were Angelita Kelly, Code 505; Dr. Cynthia Cheung, Code 631; Dillard Menchan, chief, Equal Employment Opportunity Office, Maria So, Code 441; Dr. Bhakta Rath, associate director of Research for the Naval Research Laboratory; Center Director Joe Rothenberg; Center Deputy Director Al Diaz; Center Associate Director Mary Kicaz; Dr. Hong-Yee Chiu, Code 915; Asuntha Chiang, Assistant to Senator Barbara Mikulski, and Kaleem Kawaja, Code 224, chairperson for ACAPAE.

REPORT
FRAUD - WASTE - ABUSE
NASA INSPECTOR GENERAL

GSFC Field Office
Mail Code 190
Building 1, Building 208
286-5561

HOTLINE
ANSWERS 24-HOUR
Caller can be Anonymous
1-800-424-9183

★ CALLER CONFIDENTIALITY MAINTAINED ★

Goddard NASA

The GODDARD NEWS is published monthly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

Deadline to submit material is the first of each month. For additional information contact Ernie J. Shannon (301) 286-6256.
The GODDARD NEWS Staff is:
Executive Editor: Jim Sahli
Managing Editor: Ernie J. Shannon
Contributing Editors: Donna Drelick, Tammy Jones, W. Allen Kenitzer

IMACCS

Continued from Page 1

monitoring, real-time commanding, attitude and orbit determination, attitude sensor calibration, station acquisition, data generation, planning and scheduling, and data trending. The only function not included within IMACCS, but exists on the operational SAMPEX ground system, is the task of science data preparation.

"In a subsequent, rapid integration project, the IMACCS element were combined with a combination of COTS and GOTS communication systems (a 4.3 meter antenna at modular radio frequency, interface equipment) in just a few weeks," said Meyers. Directorate management witnessed a real SAMPEX pass monitored from an end-to-end COTS system that occupied two conference tables (plus an antenna).

Since the initial implementation, the spacecraft operations automation capabilities available within the COTS tools have been exploited to create a highly-automated IMACCS configuration. New capabilities include the preplanning of pass activities, orbit navigation, the detection of anomalous behavior, and the notification of appropriate personnel. Further, the system is capable of initiating corrective action and preparing materials for spacecraft engineers to use in their evaluation of the problem.

All of these enhancements are bringing IMACCS closer to space flight control in a "lights out" environment, meaning without human intervention, said Bob Rankin of Computer Science Corporation. The preparation of evaluation materials helps turn the "lights on" when the engineer begins to evaluate the anomaly. In addition, work is underway to add the capability to prepare and distribute science data.

IMACCS Life-Cycle Activities

The implementation of the IMACCS system was completed in three months compared to the two years required to develop the original SAMPEX system. Tasks completed during the implementation effort covered a sizable portion of the normal development cycle for a typical ground system. The most significant areas not covered were the requirements development and early design phases of the typical ground system, mission requirements generation, science planning, and the operational activities. A typical ground system life-cycle development phase includes requirements development, system design, system implementation, system test, and operational support.

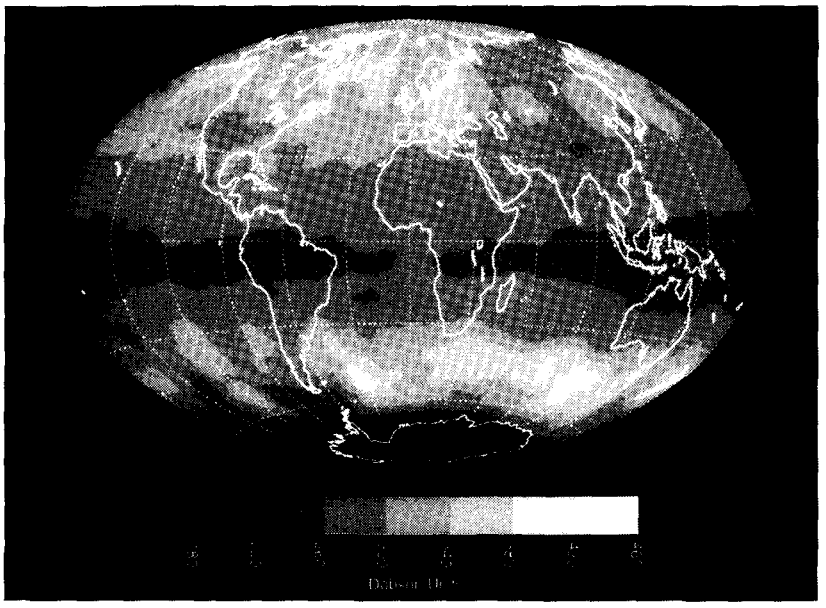
National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

Aug./Sept. 1996 Vol. 43 No. 18

Ozone Mapping Back In Business



It works! **The recently launched Total Ozone Mapping Spectrometer (TOMS) Earth Probe (EP) instrument has taken up where Nimbus-7 left off in 1992, to return its first global image of our precious ozone layer on July 20-21, 1996. The TOMS-EP team perservered in the last two years to make this moment "picture perfect." The team of employees from five of Goddard's directorates, a dozen contractors, and other military launch personnel stayed the course through a series of launch delays and an eleventh-hour replanning exercise to change orbit and mission objectives and take advantage of the overlap in TOMS-EP and ADEOS-TOMS scheduled flight times. The TOMS team created opportunity out of adversity to deliver an exciting lower orbit, higher resolution mission. See for yourself.**

This gray scale image shows total ozone levels for July 20-21, 1996. The gray scale at the bottom of the figure indicates low ozone levels in the darker shades (180) and higher ozone levels in the lighter shades (460). The dark oval at the bottom of the image shows polar night, where data is not taken.

Explorer's Quick Reflexes to Catch Images of Aurora

by Jim Sahli

Auroras have been a source of fascination and superstition for centuries. In recent decades, however, we have gained a better understanding of the phenomenon through scientific research aided by space flight instrumentation. NASA's Fast Auroral Snapshot (FAST) Explorer's "state-of-art" instruments will probe the physical processes that produce these dazzling displays and add to our understanding of Earth's environment in space.

"The purpose of the FAST spacecraft is to investigate the physics of acceleration processes in nature. Specifically, FAST will investigate how particles are accelerated in space to create the aurora or 'northern and southern lights'," said Dr. Rob Pfaff NASA Goddard project scientist for FAST.

Scheduled for an August launch from the Western Test Range, at Vandenberg Air Force Base in Calif., FAST travels to orbit on a winged Pegasus-XL launch vehicle.

The five scientific instruments onboard FAST will gather high speed "snapshots" of the electric fields, magnetic fields, and energetic electron and ion distributions at high altitudes of 1,200 - 2,600 miles and at high latitudes (greater than 60 degrees) near the Earth's magnetic poles.

FAST science complements the science investigations performed by many of NASA's other satellites in the International Solar Terrestrial Physics Program, including the recently launched Polar mission. Polar is taking images of the aurora from altitudes of eight Earth radii above the poles to look at how the auroral light is distributed within the Earth's high latitude regions. The FAST spacecraft, on the other hand, will journey to the "heart" of the aurora, the region about 1,250-6,250 miles above the Earth at high latitudes, where charged particles are energized and where they are subsequently accelerated down towards the upper atmosphere where the auroral light is emitted.

Fast Auroral Snapshot (FAST) spacecraft to study bright streamers of light in Earth's atmosphere created by electric and magnetic fields.

The FAST spacecraft includes an on-board flight computer which enables it to take high resolution "snapshots" when it encounters interesting science events. In addition, FAST will receive real time commands from scientists on the ground to operate in certain modes and to revise the selection criteria used to identify various unique features of the aurora.

FAST carries a series of instruments designed for aurora investigations: Electrostatic Analyzers to measure energetic electrons and ions, an Electric Field Experiment, and an Instrument Data Processor Unit provided by the University of California at Berkeley; a

Continued on Page 7

Surface Ultraviolet Radiation Levels Have Increased from 1979 to 1992

by Allen Kenitzer

Solar ultraviolet radiation reaching the Earth's surface has increased over large regions of the planet during the past 15 years, as the amount of total ozone in the atmosphere has decreased, according to a scientific paper published in the August 1 issue of Geophysical Research Letters.

This finding, derived from extensive analysis of data from the Total Ozone Mapping Spectrometer (TOMS) aboard NASA's Nimbus-7 satellite, is based on the known relationship between atmospheric ozone depletion and the resulting decrease in protection from ultraviolet radiation (UV-B, 290 nm to 320 nm). The accuracy of the TOMS-derived surface UV-B values has been validated by comparison with several ground-based spectrometers in Canada, New Zealand, and South America.

"The increases are largest in the middle and high latitudes, where most people live, and where the majority of the world's agricultural activity occurs," said Dr. Jay R. Herman, an atmospheric scientist at NASA's Goddard Space Flight Center, Greenbelt, Md., and the lead author of the paper, "UV-B increases (1979-1992) from decreases in total ozone."

In the paper, Herman finds that annual average UV-B exposure has increased by 6.8 percent per decade at 55 degrees north latitude, where major populations in countries such as England, Germany, Russia and Scandinavia reside. At 55 degrees south latitude, which includes the southern portions of Argentina and Chile, the increase has been 9.9 percent per decade. In North America the changes are smaller since most of the population lives below 55 degrees. The UV-B changes for regions near the Canadian border show about a 4% increase per decade.

Continued on Page 7

TOMS Rides Again

Fourth Ozone Mapping Mission, ADEOS/TOMS, Set to Launch from Tanegashima, Japan in August

by Allen Kenitzer with C. A. Buck

July 2, 1996—NASA launched the third Total Ozone Mapping Spectrometer (TOMS) on a petite, ~650 pound Earth Probe (EP)—the "littlest" Earth science spacecraft launched in the Mission To Planet Earth program—from beneath the belly of an L-1011 aircraft.

August 1996—A month later, Goddard scientists are poised to play it again, sending up the fourth TOMS mission since 1978. For this round, TOMS hitches a lift from the Japanese onboard their 3 1/2-ton, 8-instrument spacecraft known as the Advanced Earth Observing Satellite—or ADEOS for short.

NASA's fourth TOMS instrument will fly in a higher orbit than TOMS-3 (EP), sailing over the same terrain at a 800 kilometer (km) altitude above its cousin's 500 km orbit. The 300 km separation between TOMS 3 and 4—roughly the distance between Greenbelt and the Goddard Institute for Space Studies in New York City—will enable scientists to build 3-D maps of ozone columns. From its lofty view, ADEOS-TOMS will image a larger 42 km square footprint, while TOMS-EP will "peer between the clouds" to focus in on a tighter 25 km square area, according to ADEOS/TOMS principal investigator, Dr. Arlin Krueger.

The two TOMS instruments should fly in crossing orbits for the next two to three years, providing scientists with continuous ozone data and near-real time monitoring capability.

Goddard engineers have introduced several key improvements for the newest TOMS generation, enabling scientists to monitor instrument changes and maintain long-term calibrations. The measurement precision for TOMS 3 and 4 is a factor of three greater than the original TOMS, allowing researchers to accurately measure ozone concentrations within volcanic clouds for the first time. Scientists will be able to detect smaller volcanic eruptions and provide longer duration tracking of volcanic clouds which can be a danger to aircraft.

ADEOS-TOMS will image larger footprints, while TOMS-EP will "peer between the clouds" to focus in tighter.

While the instrumentation for TOMS 3 and 4 has been upgraded for higher resolution, the spacecraft duo continues the harvest of information about Earth's ozone begun with Nimbus-7 almost two decades ago, allowing scientists to track changes in the Earth's environment during our lifetime, and providing clues for the future as we uncover the mysteries our fragile atmosphere.

Cooperative Agreement Signed with Litton Industries

by Donna Drelick

Litton Industries of Goleta, Calif., has signed a cooperative agreement with Goddard to pursue the development of an Advanced Hemispherical Resonator Gyroscope (HRG). Support for this dual use technology development is provided by the Goddard Office of Commercial Programs, the Hubble Space Telescope Project, the Geostationary Operational Environmental Satellite Project, and NASA's Jet Propulsion Laboratory, Pasadena, Calif.

Design goals for the Advanced HRG include increased reliability, increased dynamic range, cost and size reduction, higher temperature and shock durability, and lower noise values. Litton now manufactures and markets a medium pointing accuracy HRG-based Space Inertial Reference Unit (SIRU). While this product will be used on several new communication satellites and spacecraft, the potential exists for increased sensitivity not currently realized in its present design.

The Advanced HRG is an excellent example of NASA's real dual-use technology. The reliability and low cost of the gyroscope will certainly benefit NASA on future missions, while it has tremendous commercial use. By working cooperatively with

Continued on Page 8

Rosa Parks Travels from History to Future on 40-City Tour

by Tammy Jones

"Freedom Riders" Stop at Goddard to Launch Model Rockets and Future Dreams.

"One small step for a man, one giant leap for mankind." These memorable words are from the Apollo 11 moon landing. They are also fitting for an earlier date in history when the actions of a black woman who took one small step would forever change race relations in this country. On a cold 1955 December day in Montgomery, Ala., Rosa L. Parks refused to give up her seat on a bus to a white male passenger. The move led to Parks' arrest, the Montgomery Bus Boycott, and a wave of protest throughout the U.S.

Parks, nationally recognized as the "Mother of the modern day Civil Rights Movement," visited Goddard on July 30, with nearly 100 students ages 11 to 17. The visit was part of the annual Pathways to Freedom tour, sponsored by the Rosa and Raymond Parks Institute for Self-Development.

The students, dubbed "freedom riders," travel with Parks to 40 cities to study history and explore the future. Their stop at Goddard was a special opportunity for exposure to careers in science and technology sponsored by the Black History Club. David Carter, in the Earth Sciences Directorate, arranged for Parks and the freedom riders to tour Goddard, see a model rocket launch, meet an astronaut, and participate in a full day of activities at the Center. Almost 500 people turned out for Center Director Joe Rothenberg's welcome and Parks' remarks. Former astronaut Fred Gregory and Hubble scientist David Leckrone also spoke, encouraging the students to strive for success.

"Pathways to Freedom" takes place over four weeks in the summer. It's an intensive educational and historical research program for students from different socioeconomic, religious and ethnic backgrounds. The students' journey traces the route of the Underground Railroad into the Civil Rights Movement and beyond.

Pathways to Freedom is more than a history lesson, a significant goal of the program requires students to enhance their interpersonal and communications skills, to instill self-esteem, and develop an appreciation for the performing arts, goal setting, career planning and budget management.

Some of the students and even adults who spent the day with Parks said that it was great just being in the presence of someone who had made a positive mark in history. Parks told *Goddard News* that she would like to be remembered as "someone who stood for freedom, equality, prosperity and all that goes with making a good life for all people."

Boot Camp

Ready. Get Set. Go.

Deputy Director for Flight Projects, Jim Moore, takes his place on the CPI assembly line for cutting, soldering and stripping a wire to make a better "Model A." Fellow pupils time the operation and observe the number of steps required to complete the task.

Twenty senior managers signed on for three days at Continuous Process Improvement (CPI) Boot Camp this summer. Top brass rolled up their sleeves and set about the business of improving work practices and processes. CPI's hands-on approach fosters teamwork and teaches the troops to look critically at how work is accomplished.

CPI HONOR ROLL

100	Joe Rothenberg, Director	400	Vern Wyers, Flight Projects
100	Al Diaz, Deputy	400	Jim Moore, Flight Projects Deputy
180	Mary Kicza, Assoc. Director Space Sciences	405	Charlie Vanek, Tracking and Data
100	Kathy Nado, Special Assistant	500	Art Fuchs, Mission Operations
110	Jerry Simpson, Human Resources	600	Steve Holt, Space Science
114	Wayne Boswell, Training	700	Al Sherman, Engineering
130	Jan Ruff, Public Affairs	700	Mike Fitzmaurice, Engineering
150	Nancy Abell, Deputy Comptroller	700	Mitch Brown, Engineering
200	Sherry Foster, Management Operations	800	Arnold Torres, Suborbital Projects
300	Bob Baumann, Quality Assurance	900	Vince Salomonson, Earth Sciences

Celebrate Goddard Day

by C. A. Buck

Fun.

July 12—A warm, misty breeze. Overcast skies. The calypso beat of Caribbean steel drums. Aromas suspended in humid air of spicy curried dishes, tropical seasonings, and fragrant, sweet plantains. People calling out to one another, exchanging greetings and catching up on news as they crowded around exhibit booths and jammed long food lines. The scene was festive for more than 4,000 participants in the first "Celebrate Goddard Day." Big canvas tents dotted the lawn in front of administration building 8. The rain held off.

The event was a day to remember. "It's the first time I can remember something like this happening here at Goddard. I think it's a good idea," employees said. "We are people from many nations," said the Center Director. The governor's office made it official, issuing a proclamation designating July 12th as "Celebrate Goddard Day."

Festival.

Participants celebrated the many different cultures and countries represented in Goddard's workforce with food and entertainment from three continents, 10 countries, and more than a dozen unique cultures. Employees also listened to Byron Kunisawa's thought-provoking keynote address.

Many traded traditional business attire for clothes of many colors and creeds. At the Music and Drama (MAD) table, Bill Struthers, clad in his MacDonald Scottish kilt and matching knee socks, recruited talent for the upcoming musical. Wearing his gold letter Alpha Phi Alpha African-American international fraternity t-shirt, Leon Holmes manned his booth, handing out free news papers on behalf of his 15 frat brothers at Goddard. Eight Indian folk dancers, draped in red and silk dresses fringed with gold, posed for a photograph at the side of the main stage. Men and women in colorful kente outfits and dashiki shirts mingled, as a smiling older gentleman wandered through in his traditional Bavarian lederhosen—leather shorts and suspenders. Fidos for Freedom—specially trained seeing-eye-dogs—and their owners dispensed information on their programs and the Advisory Committee for People with Disabilities.

Food.

"There are a lot of people here working together. That's basically what it's all about," said event co-chair Sheri Thornton.

Multiculturalism

The Greater the Inclusion, the Greater the Solution

Sheri Thornton, Hubble Financial Manager and* Celebrate Goddard Day *Co-Chair

Thornton and daughter, Shamara.

Have you ever had to plan, build, or just get something done when you weren't sure what you needed to do, how you needed to do it, or what it was supposed to look like when it was done? This is where we started on the Celebrate Goddard Day Committee.

While I was excited about being involved in a Center-wide event for all employees, I was also apprehensive about the challenge. I'd never done this before, and neither had Sandra Irish, my event planning co-chair. Our starting position was that no one had all the answers. We needed team of more than 40 people from ten directorates serving on four committees to get the job done. We viewed everyone as a resource. What evolved in less than three months was remarkable.

I think that people don't always recognize the potential rewards of delving into the unknown. We all are capable of coming up with fresh, exciting, and successful ideas. Facing new challenges forces us to shift our thinking forward and into a higher gear. It forces us to dig deeper, use ingenuity, and tap creativity and spontaneity that are often overlooked.

I am not suggesting that we should start from scratch with new people every time we begin a project, or that we should overlook the value of experience, history, and lessons learned. Instead, I would challenge my co-workers to look for ways to include people with different experiences and perspectives in their projects. It may seem risky—but considering the new opportunities created and the potential rewards—it is worth forcing ourselves and others to venture into new and unknown territory. You could be doing yourself a favor, and achieving a level of success beyond what you could attain or imagine on your own.

For me, the feedback on Celebrate Goddard Day has been overwhelmingly positive. Some people have said that despite it being a "first," the day went well. Instead, I'd say it was the absence of a precedent that made Celebrate Goddard Day a success.

Keynote Excerpts

The following quotes are excerpted from remarks made by multiculturalism trainer, Byron Kunisawa.

"When you move forward as an organization, it is important that you understand that festivals like this go on everywhere in the country. It is not the same as what you do. The reason for that, in many organizations, is this is all that they do. They have no way to integrate this concept into what goes on every single day. When you only do these ethnic celebrations, let me tell you what we create. If your model is simply comprised of ethnic food and ethnic music, then the only outcome that you produce will be fat people that can dance."

Photos by Mark De Bord

Progress Report

"Nine years ago this day would not have been a reality. We argued and fought about this issue and concept nine years ago. At least today we are having discussions about whether or not the concept of multi-culturalism has utility or not. There is enough of a nucleus here at Goddard to begin to move forward.

Even though God-dard has progressed, I think our nation has regressed. We are far beyond 'at risk' and entering what he calls crisis and chaos. The country is in denial. Why? Because of apathy and a lack of leadership."

The Barbecue Story

"In this country, I believe that when we can't solve problems we look for scapegoats. What I find frightening is the new scapegoating of illegal aliens. In a country that can't differentiate immigrants from citizens, all of us who look different are viewed as illegal aliens.

Let me use the example of hosting a barbecue. We invite ten people. We make sure that we have enough food for at least 15. We feel comfortable. But then, some of our friends have friends drop in on them. They show up at your doorstep, and you want to appear like this gracious host or hostess. So you say, 'No problem. Come on in.'

Then you tell your spouse, 'Honey, we've got a problem, because there are 25 people out there, and we've only got food for 15.' So you try to figure out how to divide up the food when someone else comes in and says you've got a bigger problem than that. Some of the people are vegetarians.

And you say, 'Why in the he heck would a vegetarian come to a darn barbecue in the first place?' So while you are trying to make parsley and catsup vegetables to pass around, somebody else comes in and says, you've got another problem. Some of the friends are Jewish, and they can only eat kosher food. If you have to ask, what is kosher food, you don't have to look in your cupboard. You ain't got none.

What you will experience in trying to entertain at this barbecue is what this country faces every single day. There are more people here today than we ever thought would be here. With more unique and different needs and expectations than we have ever had to address in the history of this country. And our problem today is that we don't have the understanding and the capability at this point in time to address those needs. So if you can't address them, you turn the problem on the guests. And I'm saying that's what goes on every single day. If we focus here on the NASA system at Goddard, I believe that you are focusing and moving in the right direction."

Half the Equation

"At NASA, we only have half of the equation: technology. The other half is diversity. Your task is to try and develop an institution that is both compatible with accommodating changing technology, but also accommodating the changing diversity. Because if you're able to match the technology with the diversity then you will ultimately have the capability to move forward. If you don't have that match, technology does not move by itself. Because NASA is such a leader in technology, as an organization we run the risk of thinking that our technology alone can carry us."

The Challenge

"We are a nation at the crossroads of crisis and change. It is critical that we take the high road through change. Freedom only has value when we all share it. Equality only has value when we all have it. Your job is not to solve the problem. Your job is to be willing to commit to the struggle for change in this country so that everybody will ultimately live the life that should be a given to every individual in our society.

The challenge right now is to get employees to see this as part of work. People look at

Continued on Page 6

KUNISAWA Continued from Page 5

is as, 'this is not my job.' They ask, 'What's in it for me?' Rather than looking at it from the perspective of what might I learn by participating, or what is interesting about the experience for all of the people who have chosen to be here.

Until we change the attitude from not, 'What do I get out of it,' but what are other people going there for, and what can I learn about those other people that could benefit me in working more effectively, we will not have truly progressed."

❖ ❖ ❖

Kunisawa does not blame leadership or make white men the scapegoat for failures to fully embrace a multicultural approach. Instead, he explains that, "the problem is one of breaking the cycle of old behaviors that helped to make you successful in the past."

"I do know that not everyone has come to training," he says. Kunisawa is not concerned when people question multi-culturalism training, but he does gets concerned when they don't show up.

Stepping Up to the Challenge

Following Kunisawa's remarks, Goddard managers participated in a panel discussion on multiculturalism and diversity. Deputy Center Director, Al Diaz, described Goddard's discourse and efforts to grapple with multiculturalism and diversity issues saying,

> "Becoming a multicultural organization is going to take some action. Unless we learn to act together to achieve the common objectives, we are not a multicultural organization. Unless we are inclusive of all of our differences, rather than exclusive, I think that we have missed the opportunity for benefit. The fact is that we are different as individuals. People are not going to perform to their fullest, unless they feel at least respected, if not totally comfortable.
>
> If you look at the demographics in the year 2000, unless the organization is multicultural, it will deprive itself of the best and brightest. If people don't feel respect, they are not going to seek employment with us.
>
> In the scientific enterprise there is an additional value that multiculturalism brings. Diversity provides an enhanced capability to solve problems because of the different view points brought to the bear on a problem."

Thumbs Up for Hitchhiker TEAMS Performance

All Systems Were "Go" for Goddard Special Payloads Flown on Recent Shuttle Mission

by Tammy Jones

When NASA launched Space Shuttle Endeavour STS-77 on its the 10-day mission with its record-breaking four planned rendezvous, several Goddard-managed payloads were on board. Neal Barthelme, mission manager in the Special Payloads Division, says STS-77 was the second shuttle mission in less than a year to fly three bridges from his Division at the same time. (STS-69 also carried a trio of Goddard special payloads.) The shuttle's Hitchhiker carrier this time contained four experiments called Technology Experiments for Advancing Missions in Space (TEAMS).

Barthelme and more than 200 of his colleagues compared notes on TEAMS' outstanding performance with the STS-77 astronauts this summer when the crew visited the Center for post-mission briefings. While much of the data remains to be processed, early indications show that all went well for Goddard's STS-77 payloads. Here's the run down.

TEAMS

✔ ***Goddard's Passive Aerodynamically Stabilized Magnetically Damped Satellite (PAMS) did exactly what it was supposed to do.*** This pint-sized free-flyer doesn't need a steering wheel to stay on course. PAMS is a technology demonstration designed to test aerodynamic stabilization as a means for maintaining satellite direction. PAMS consists of a small deployed satellite and a measuring system to observe the satellite during a Shuttle mission. Linda Pacini, PAMS experiment manager, said the satellite performed as expected, "This demonstrates that aerodynamics stabilization techniques work."

✔ ***Refueling experiment topped off the*** tank. The Vented Tank Resupply Experiment (VTRE) was designed to test

Continued on Page 8

Newsmakers

Frank Ceppolina makes the grade at Santa Clara University (SCU). The school awarded former alum Ceppolina with its Distinguished Engineering Alumni Award, printing a full-page profile on the HST Flight Systems and Servicing Project Manager for the school's magazine. "When Ceppolina came to SCU in the late 50's, he wasn't particularly interested in rocket science. He was more a 'model airplane guy.'" Let's hear it for the class of '59.

Dennis Christopher is the Cable Guy. Bucks County Cablevision in Pennsylvania made the Goddard Education Specialist a local celebrity with their 8-part interactive TV program called "Lift-Off to Learning," broadcast for more than 1,400 students. Christopher brought the excitement of space down to earth for his MTV-generation audience with video clips, live demonstrations, and interviews with astronauts. His work will also be featured in the Time Warner Corporation's trade magazine. "One of the major advantages of cable is knowing our customers and being able to meet the specific needs of each individual community," said the Cable Station's appreciative programming director.

High praise for Mission Operations and Data Systems project manager, Algelita Castro Kelly. Featured in a new book of 70 outstanding role models, "Filipino Achievers in the USA and Canada: Profiles in Excellence," Kelly is recognized for her professional achievements and dedication to mentoring others. Phillipine President, Fidel Ramos, commends Kelly "for her significant work which gives well-deserved recognition to our countrymen who have succeeded despite many obstacles."

Jeannette Benavides is rocking "La Nacion." Featured in a full-page color story appearing in Costa Rica's major newspaper, "La Nacion," the flight assurance technologies chemist and materials engineer talks about the importance of the EOS program, and opportunities for Costa Rica to participate in this interdisciplinary, international program.

Alan Binstock gets thumbs up verdict from Washington Style. A photo and article on Binstock's sculpture appeared in the Washington Post Style article, "Sculptor Acquits himself well in Greenbelt Show." The Facility Management Division's architect exhibited his flagstone and steel works at the Federal Courthouse this summer, winning rave reviews. A project manager at Goddard, Binstock is perhaps best known for his sculpture in the Building 1 cafeteria: a design and installation in the serving area which resembles space hardware.

A Scholar's Journal

by Kelly Fox, 1996 National Space Club Scholar & Atholton High School Senior, Columbia, MD
Mentor: Mr. Ian Sprod, TOMS Atmospheric Scientist

DAY 1: After receiving my security badge without incident, I met three other Space Club Scholars. We stuck out as summer students, who didn't know where to go, how to get there, or who to ask. Realizing we were stronger united, we immediately bonded. The four of us introduced ourselves and walked together to Building 3. The tight security quickly changed my first day jitters into precautionary panic. Absorbing important details, we noticed the door was flanked by a keycard security device and stated only employees with proper clearance could enter. Determining that we were at the right building, we proceeded through the double doors. I held my breath, and waited for the alarms, guards, and dogs. Silence. No one jumped out from behind the bushes. We were safe. We were at the right building. And...we were early.

> Here, the excitement of science is the invisible force that ties everyone together.

Meeting the others students and going to the orientation helped calm everyone's nerves. Our coordinator's easy going nature and great sense of humor rubbed off on the group. We even grew excited at the prospect of six weeks at Goddard. At the orientation we were warned of three very important items. Number one, the security guards carry guns. Number two, the geese always have the right of way. And number three, in order to survive on Center you must learn to speak "Acronym". No one warned me about Goddard's intense scientific atmosphere. I guess I should have known better.

After meeting my mentor, Ian Sprod, I followed him to Building 22. We discussed acronyms, and I learned a new one, TOMS (Total Ozone Mapping Spectrometer). That brought my AEL (Acronym Experience Level) to three: NASA, GSFC, and TOMS. I observed that there were an overwhelming number of chalkboards. They're on every floor and in most hallways and offices. It reminded me of my high school. The only difference was that these chalkboards were well stocked with chalk, prepared for even the most spontaneous of thoughts.

I was most amused with the toilet paper dispenser in the ladies rest room. It read like directions designed for the Shuttle: "when empty flip access door." Only at NASA.

The scientific atmosphere remained strong in even the cafeteria. The TV in the corner continually pumped Weather Channel satellite pictures into the busy room. Conversations surrounded the latest launch, the next colloquium, and future projects. The salt shaker became the Shuttle as it rendezvoused with the Spartan carrier (a.k.a. the pepper shaker). And boy did the acronyms fly!

> "The salt shaker became the Shuttle as it rendezvoused with the Spartan carrier"

I've found that Goddard is full of scientific influence. Here, the excitement of science is the invisible force that ties everyone together. I understand now that it is that excitement that I saw in the eager expressions of many of my colleagues that first day. Eager to learn, eager to understand, and eager to share.

FAST Continued from Page 1

FAST is the second of five missions in NASA's Small Explorer (SMEX) Project developed by Goddard. The SMEX satellites are highly capable, small observatories for quick response astrophysics and space physics investigations.

"Innovative engineering and new technology advances have increased the potential scientific return of the SMEX spacecraft to a level comparable to larger carriers. The design has struck a balance between mission risk and cost that has allowed for the development of an extremely capable spacecraft within just three years time. The SMEX program well embodies the faster, better, cheaper concept," said James Watzin, SMEX project manager at Goddard.

OZONE Continued from Page 2

"This confirmation that we can use a space-based sensor like TOMS to measure long-term global surface ultraviolet radiation levels represents a very powerful new tool for Earth Scientists and others to use both now and in the future," said Dr. Robert Harriss, Director of the Science Division, of NASA's Office of Mission to Planet Earth, Washington, D.C.

Ozone, a molecule made up of three atoms of oxygen, is found in the atmosphere between the ground and about 37 miles (60 kilometers) in altitude. Ozone absorbs ultraviolet radiation from the Sun and shields life on Earth from its harmful effects. Scientists and others have a keen interest in ozone depletion, given that the increased amounts of ultraviolet radiation that reach the Earth's surface because of ozone depletion, have the potential to increase the incidence of skin cancer and cataracts in humans, harm some crops, and interfere with marine life.

TEAMS Continued from Page 6

improved methods for in-space refueling. The results of the experiment will be used in future designs of spacecraft liquid propellents. All VTRE video and digital data was recovered, and large quantities of unique and interesting data were returned. The Lewis Research Center experiment videotaped red-dyed freon as it was transferred at different fill rates from one tank to another and back again.

✔ ***Hitchhiker passenger turned up the heat on microgravity experiment.*** The Liquid Metal Thermal Experiment (LMTE), sponsored by the Air Force's Phillips Laboratory, in Albuquerque, N.M. LMTE looked at the performance of liquid metal heat pipes in microgravity conditions. LMTE turned out the hottest heat pipes in space history at >900 degrees Fahrenheit. The experiment was successful with its hardware and software, real time control and data acquisition obtained through ground support equipment at the Goddard's Hitchhiker Payload Operations Control Center.

✔ ***Navigation experiment pointed the compass for future space station orienteering.*** The Global Positioning System (GPS) Attitude and Navigation Experiment (GANE) is a Department of Defense navigation system that allows world-wide navigation capabilities. GPS allows pilots, boaters, hikers and others accurate real-time position and velocity determination. The International Space Station will use GPS for position, velocity, time information and attitude determination. GPS met its mission objectives.

SPARTAN 207

✔ ***The Spartan 207/Inflatable Antenna Experiment (IAE) also flew on this mission and was successful.*** Data from the spacecraft indicate that all systems functioned as intended. Mark Steiner, Spartan 207/IAE Mission Manager said that L'Garde, Inc. of Tustin, Calif., the builder of the IAE, is still evaluating data from the flight. "They were very pleased with the quantity and quality of the photo and video documentation from Endeavour. They said that it appears that the antenna portion of the IAE did not fully inflate, and are working to understand just what exactly happened," said Steiner. The flight hardware has been removed, and is in storage for future flights.

There also were ten GAS experiments on the STS-77 mission.

LITTON Continued from Page 6

industry, NASA is helping to bring these benefits to the American public," said George Alcorn, Chief of Goddard's Commercial Programs Office.

The value of the product attracts industry contributions. NASA is not the major financial contributor for the product. This represents a new way of doing business within the demands of a shrinking federal budget."

The successful development of the advanced gyroscope will greatly increase safety and reduce costs associated with various commercial activities, such as oil exploration and drilling. Current tools used by the oil industry for measuring the depth and direction of a drilling location have limited accuracy and dependability. The Advanced HRG allows for a single tool to measure depth and direction while drilling and surveying.

Designs for the Advanced HRG will be evaluated and validated by GSFC, JPL, Litton, and the California State Defense Conversion Council.

Subscription Information:	***Contact:***
GSFC & WFF Mailing List	**Gweny Durrah**
Offsite/Commercial Subscriptions	**Darlene Ahalt**
Retiree Subscriptions	**Bob Wilson (301/422-8334)**

Goddard News
National Aeronautics and Space Administration — Goddard Space Flight Center — NASA

The GODDARD NEWS is published monthly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

UPCOMING EVENT

Goddard Community Day

Activities for the whole family include:

Engineering Fair
Guided tours of Center
Living-in-Space Demos
Model Rocket Launches
Control-Line Model Aircraft Demos
Discover Goddard Speaker

September 15, 1996 9 a.m. to 4 p.m.
For more information, call (301) 286-8981

Deadline to submit material is the first of each month.
For additional information contact C.A. Buck (301) 286-7205.
The GODDARD NEWS Staff is:
Executive Editor: Jim Sahli
Acting Managing Editor: C.A. Buck
Senior Photographer: Mark DeBord
Contributing Editors: Donna Drelick, Tammy Jones, W. Allen Kenitzer

Goddard News Editor, Ernie Shannon, leaves for Columbus, Ohio and a promotion to Public Affairs Director at the DOD Finance and Accounting Systems Center. Best of Luck! We'll miss you.

National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

October 1996 Vol. 43 No. 18

High Energy Payloads Launch from Wallops on Pegasus

by Jim Sahli

With two successful NASA Pegasus launches completed in 1996, Goddard will fly again on a Pegasus rocket to place two space science spacecraft into orbit this October from Wallops.

The spacecraft are an Argentine satellite called SAC-B and an MIT-built payload called HETE. The two missions will study gamma rays and other astrophysical, high energy, and solar events.

SAC-B (Satelite de Aplicaciones Cientificas) is an international cooperative project between NASA and Argentina's National Commission of Space Activities (CONAE). The spacecraft is designed to advance the study of solar physics and astrophysics through the examination of solar flares, gamma ray bursts, diffuse X-ray cosmic background, and energetic neutral atoms.

"The primary goal of SAC-B is to develop and test scientific technology on a new, light, capable spacecraft designed and developed in Argentina. Follow-on spacecraft will form a series of light spacecraft for space applications, scientific investigations, and technology development," said Dr. Mario Acuna, project scientist for SAC-B in Goddard's International Projects Office.

NASA is providing two scientific instruments, launch services on the Pegasus' launch vehicle, and support for initial orbit operations and emergency backup throughout the mission life. CONAE is responsible for the design and construction of the SAC-B spacecraft, the Hard X-ray Spectrometer (HXRS) instrument, the ground station and the scientific data distribution.

Under a separate agreement between Argentina and Italy, the Italian Space Agency (ASI) is providing the solar arrays plus a scientific instrument. Also under an additional separate agreement between Argentina and Brazil, the Brazilian National Space Research Institute (INPE) is providing the facilities required to perform environmental testing of the spacecraft.

SAC-B, a 400-pound (181 kilogram) class spacecraft, launches from the Pegasus XL expendable launch vehicle which mounts to a Lockheed L-011 transport aircraft. Launch operations will take place at the Goddard's Wallops Flight Facility in Virginia.

SAC-B's Mission Operation Control Center located at San Miguel (just outside of Buenos Aires, Argentina) will be

Continued on Page 2

New Technology Could Save 130 More Lives Annually

NASA leads in installing new aircraft technology to assist with search and rescue

by Allen Kenitzer

NASA is among the government agencies leading the way to install new technology which could save 130 more lives annually once placed on all general aviation aircraft, according to a NOAA study.

The National Oceanic and Atmospheric Administration (NOAA), United States Coast Guard and NASA recently completed the installation of newly-available satellite-compatible Emergency Locator Transmitters (ELTs) on six aircraft. The new transmitters are designed to eventually replace 1970s technology ELTs that are currently installed in the U.S. general aviation fleet, which numbers over 200,000 mostly small single-engine aircraft. The aircraft selected to receive the new ELTs include a NASA DC-8 research plane, a NOAA P-3 "hurricane hunter," and Coast Guard command, search, and recovery aircraft. The sixth plane is a twin-engine Aero Commander that is flown by NOAA at low altitudes in remote areas to measure the water content of snow packs.

NASA has gotten a jump start on the aviation industry by voluntarily converting to the new technology ELTs in advance of a Federal Aviation Administration (FAA) ruling for conversion of the entire general aviation fleet.

"We're excited about the installation of this new technology," said Ron Wallace, Goddard's Search and Rescue Mission Manager. "We hope that other general aviation plane owners will follow our lead and update their own beacons."

ELTs were originally designed to be detected and located by overflying aircraft and fixed radio receivers. Soon after ELT installation was mandated, the FAA learned that many distresses were not being detected. Consequently, NASA initiated a research and development program to see if ELT signals could be detected and located from space. Today, space-borne instruments are the primary sensors used for locating missing aircraft.

Continued on Page 8

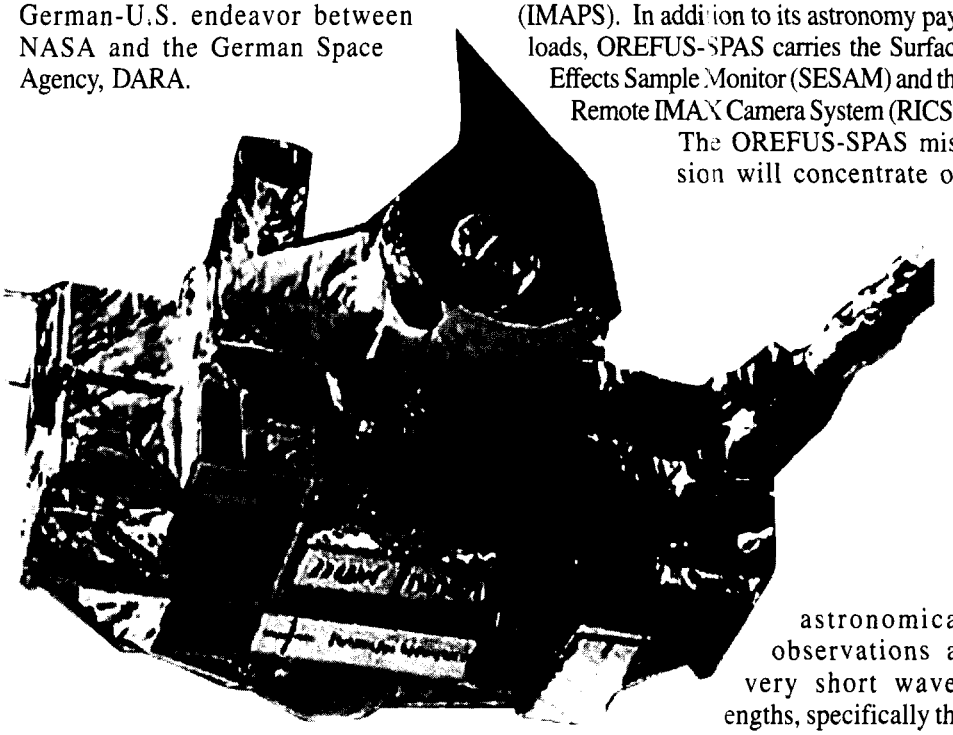
Hot and Cold Running Observations

ORFEUS-SPAS-2 Explores New Territory in the UV

by Jim Sahli

Goddard scientists will be among the U.S.-German science team working together on the Orbiting and Retrievable Far and Extreme Ultraviolet Spectrometer - Shuttle Pallet Satellite-2 (OREFUS-SPAS-2) mission. Scientists will travel to Kennedy, where the science mission operations will be conducted during the 16-day Shuttle flight. The OREFUS-SPAS astrophysics mission will investigate very hot and very cold matter in the universe.

This fall's flight is the third in a series of missions using the German built ASTRO-SPAS science satellite. The ASTRO-SPAS program is a joint German-U.S. endeavor between NASA and the German Space Agency, DARA.



"ORFEUS-SPAS-2 will attempt a large number of observing programs. We hope to gain new insights about the evolution of stars, the structure of galaxies, and the nature of the interstellar medium," said U.S. mission scientist for ORFEUS-SPAS-2, Dr. Ron Polidan of Goddard's Space Science Directorate. "While we are in space for 16 days aboard Atlantis, we will be exploring new territory. Many of the objects we are looking at have never been observed before in the ultraviolet," said Polidan.

ASTRO-SPAS is a spacecraft designed for launch, deployment and retrieval by the Space Shuttle. Once deployed from the Shuttle by its Remote Manipulation System (RMS), ASTRO-SPAS will operate quasi-autonomously for 14 days in the Shuttle vicinity. After its free flight phase, the satellite is retrieved by the RMS and returned to Earth.

The one-meter diameter OREFUS Telescope with its Far Ultraviolet (FUV) Spectrograph and Extreme Ultraviolet (EUV) Spectrograph is the main payload for ORFEUS. A secondary, but highly complementary payload is the Interstellar Medium Absorption Profile Spectrograph (IMAPS). In addition to its astronomy payloads, OREFUS-SPAS carries the Surface Effects Sample Monitor (SESAM) and the Remote IMAX Camera System (RICS).

The OREFUS-SPAS mission will concentrate on astronomical observations at very short wavelengths, specifically the two spectral ranges Far Ultraviolet (FUV, 90-125 nanometers) and Extreme Ultraviolet (EUV, 40-90 nanometers). This part of the electromagnetic spectrum is obscured by the Earth's atmosphere, making it unsuitable for ground-based observations. The region is extremely interesting to astronomers since it possesses one of the highest concentrations of spectral lines, including the lines for various states (at various temperatures) of hydrogen and oxygen — key elements for life.■

High Energy Continued from Page 1

the focal point for mission operations. An Argentine flight operations team will be responsible for the spacecraft and instruments, as well as tracking, data acquisition and science data management. The Wallops and the Bermuda Island tracking station will provide complete powered flight ascent coverage. The Wallops Tracking Station will provide launch support command and engineering telemetry support augmented by the Deep Space Network which will provide one contact per orbit for up to 30 days after launch.

SAC-B will carry three astronomical instruments. The scientific payload is comprised of the Argentine-built HXRS instrument which was developed by the Institute of Astronomy and Space Physics. HXRS will study changes in the spectra of gamma-ray bursts and solar X-ray flares.

Goddard will provide two detectors to measure soft X-ray emitted by solar flares and gamma ray bursts. The instrument is called the Goddard X-ray Experiment (GXRE). A diffuse X-ray background detector, the Cosmic Unresolved X-ray Background Instrument using CCDs technology (CUBIC), is being provided by Penn State University. It will map the X-ray sky to study the background radiation emanating from the galaxy and the universe. Also flying will be an Italian instrument called ISENA to measure energetic neutral atoms.

The SAC-B spacecraft will be launched with its companion payload, the High Energy Transient Experiment (HETE). HETE is a Massachusetts Institute of Technology mission coordinated with the Goddard International Projects Office.

HETE will carry three instruments: a gamma-ray burst detector; an X-ray camera; and ultraviolet cameras. Investigators will use these instruments to detect a gamma-ray burst and observe its associated X-ray emissions, obtaining a general location in the sky before finally using the UV cameras to pinpoint fainter UV emissions to determine burst location with a high degree of precision. Information will be continuously transmitted in real time to enable numerous ground observatories to participate in rapid co-investigations of observed targets.■

Hubble Sees Early Building Blocks of Today's Galaxies

by Tammy Jones

On Sept. 4, NASA Hubble Scientists announced the discovery of galaxies "under construction." New Hubble Space Telescope images reveal what may be galaxies under construction in the early universe, out of a long sought ancient population of "galactic building blocks."

Hubble's detailed images, taken with the Wide Field Planetary Camera-2, reveal a grouping of 18 gigantic star clusters that appear to be the same distance from Earth, and close enough to each other that they will eventually merge into a few galaxy-sized objects. They are so far away, 11 billion light-years, that they existed during the epoch when it is commonly believed galaxies started to form.

These results add weight to a leading theory that galaxies grew by starting out as clumps of stars, which, through a complex series of encounters, consolidated into larger assemblages that we see as fully-formed galaxies today.

The finding is another step back into the dim past, where astronomers ultimately hope to uncover the earliest seeds of galaxy formation which arose shortly after the birth of the universe, or the Big Bang.

Astronomers at Arizona State University, Tempe, Ariz., (ASU) and the University of Alabama at Tuscaloosa found 18 of these cosmic building blocks packed into an area about two-million light-years across. "It's the first time anyone has seen that many star-forming objects in such a small space.There are not nearly as many such luminous objects in the two-million light-years separating Earth's galaxy, the Milky Way,from the Andromeda Nebula, the nearest major galaxy," says Rogier Windhorst of ASU.

The astronomers published their findings in an article, authored by ASU graduate student Sam Pascarelle, in the Sept. 5 issue of the journal Nature.

The building blocks seen by Hubble consist of only about a billion young stars each, and Hubble shows star formation is underway through the presence of many blue stars and glowing gases. The objects typically measure only 2,000 light-years across. "That's not very big. Our own galaxy is 100,000 light-years across," Odewahn says. The objects are much smaller than even the central bulge of the Milky Way, which measures about 8,000 light-years in diameter.

"We think that by repeated merging, they will grow big enough to become the bulges of nearby galaxies," says Keel, citing other Hubble studies that have shown that the galaxy merger or collision rate was higher in the past. "In fact, at least four of the objects in this field show double structure in their centers only a few thousand light-years apart, as if we've caught them in the act of falling together."

Hubble shows a new level of detail for determining the true nature of these "pre-galactic blobs." Hubble resolved clumps as small as 2,000 light-years across (1/10th of an arc second). These were seen in a two-day (67-orbit) exposure by Hubble of a small region of sky in the northern part of the Hercules constellation near the border with Draco.

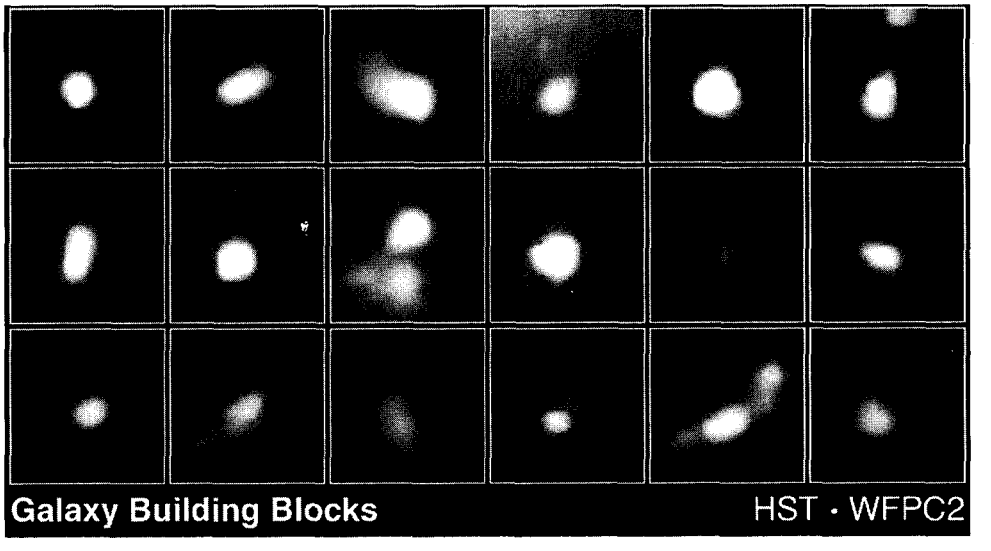
"We've never seen so many of these objects in a single exposure and so small," says Pascarelle. "We are convinced that these objects are not peculiar, but part of the general formation process of galaxies in the early universe."

Astronomers see stars form, because star formation is an ongoing process. However, astronomers have never directly seen galaxies form, because their formation may have happened a long time ago, or because galaxy formation is not as spectacular as once believed, and is therefore much harder to observe.

The idea that galaxies grew from small pieces coming together, rather than through the collapse of a gigantic gas cloud, has been predicted from previous theoretical work and ground-based observations. The Hubble observations offer some of the best direct visual evidence to date, says Pascarelle.

"Though many of the objects are isolated in the image, they are close enough together in space that most of them should eventually merge," according to Windhorst. He sketches a scenario where two or more objects will pass through each other, drawing out hydrogen gas to form more stars later. (Although the term "collision" is used, their individual stars don't collide.) They may then evolve to form the numerous faint blue galaxies, a distant population of galaxies seen by Hubble and other telescopes. Later, surrounding hydrogen gas then settles into a disk to form a spiral galaxy.

If this construction plan is correct, our Milky Way galaxy contains all the pieces of the assembly process. The older, redder stars in the Milky Way's central bulge came from the merged clusters, or "sub-galactic units," seen by Pascarelle and collaborators. The spiral arm that our Sun inhabits was made later after hydrogen settled into a disk. Some of the 140 globular star clusters which orbit the Milky Way may be "left over" smaller building blocks which formed before the larger units seen by Pascarelle and collaborators, but were never pulled directly into larger assemblages.



GIF and JPEG images, captions and press release text are available via World Wide Web at:

http://www.stsci.edu/pubinfo/PR/96/29.html
and via links in:
http://www.stsci.edu/pubinfo/Latest.html or
http://www.stsci.edu/pubinfo/Pictures.html.■

The Sunset of SSBUV, Goddard's 'Frequent Flyer'

by Denise Konopka

The sun is a major driver in what happens naturally with ozone. The sun's output, particularly its output in the ultraviolet (UV) region of the spectrum has great influence on the chemistry and dynamics of the Earth's atmosphere. Knowledge of temporal and spectral solar irradiance changes, particularly in the middle and near UV, are needed to study and understand the thermal structure, dynamics, and energy budget of the Earth's middle atmosphere. Scientists also use measures of ozone to study the combination of natural influences (like the sun) and imposed influences (like human behavior). To do so requires accurate measurements over long time intervals.

The Shuttle Solar Backscatter Ultraviolet (SSBUV) instrument, developed at Goddard was designed to measure ozone concentrations by comparing solar ultraviolet radiation with radiation scattered back from the Earth's atmosphere. The SSBUV is one instrument that helps scientists to understand natural short- and long-term changes that impact how the sun changes.

In late 1989, the Space Shuttle Atlantis carried the first flight of the SSBUV instrument. Since then, SSBUV has made eight flights. The most recent (and final one) was as part of the Atmospheric Laboratory for Application and Science-3 (ATLAS-3). After eight successful flights, the SSBUV has collected data that will also help scientists maintain the long-term accuracy of the daily ozone measurements.

Tracking solar UV changes requires a high degree of accuracy to thoroughly understand the role of solar variations on atmospheric change. To increase the accuracy, reliable instruments that are carefully and regularly calibrated are needed. SSBUV underwent rigorous calibration before and after flight. In fact, the SSBUV program pursued a vigorous laboratory calibration effort with standards traceable to the National Institutes for Standards Technology. This also enabled scientists to compare observations of several ozone measuring instruments such as those aboard the Upper Atmosphere Research Satellite (UARS) and others.

SSBUV's impact on NASA's ability to detect ozone trends was realized during the fourth SSBUV flight, when the instrument was carried as part of the ATLAS package.

Student Experiments Hitch a Lift

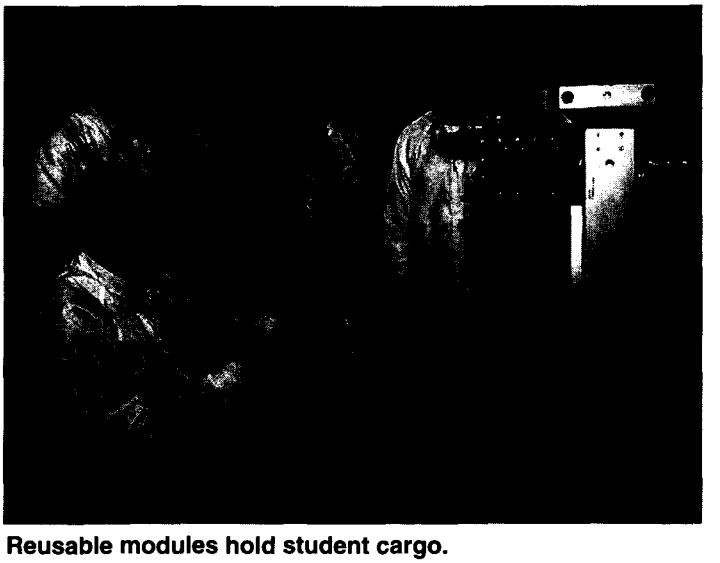
From Silly Putty to Dahlia Bulbs and a Fluid Thermal Convection Apparatus: Students from Kindergarten through College Fly their Science Projects in Space

by Tammy Jones

A new educational initiative at Goddard takes students' science lessons from the chalkboard to the launch pad this fall. The Space Experiment Module (SEM), conceived and managed by the Shuttle Small Payloads Project, targets kindergarten through university level students. Students develop their own experiments and use SEM hardware to carry the payloads into space.

"SEM stimulates and encourages hands-on/minds-on student participation in the creation, development, and potential flight of zero-gravity and micro-gravity experiments on the Space Shuttle," said Dr. Ruthan Lewis, SEM mission manager.

Student experiments will make their maiden voyage flight on board STS-80 with the ORFEUS-SPAS-2 mission this fall. The student payloads will be flown inside ten reusable containment modules for experiments within a 5-foot Get Away Special canister. The system includes an internal support structure, battery, power distribution system, devices for data sampling and storage, and a harness — all provided by GSFC. Experiments may be "active" (requiring power) and/or "passive" (non-powered). Prior to flight, customized data sampling schemes are programmed for each experiment. Data reduction and processing are completed post-flight.



Reusable modules hold student cargo.

When data from three different instruments on board ATLAS-1 were compared with one another, the agreement between the three data sets was excellent.

These instruments had been calibrated against three independent absolute standards. Because calibrations of the three instruments were based on independent standards, the information about solar spectral irradiance is now known with much better accuracy. This is a much improved confidence over historical measurements, and means that the data furnishes a good baseline for future solar measurements.

SSBUV observed the sun from the Space Shuttle a total of eight times from 1989 through 1996, making it one of the most frequently flown payloads in the Shuttle's Cargo Bay. The measurements obtained during SSBUV constitute the longest solar UV data base made with an instrument calibrated preflight, inflight, and postflight. Launches of other BUV instruments in the future will provide a unique opportunity to intercompare the new generation of ozone measurements with those that have been in orbit for some time.

Interested readers make check out the SSBUV web site located at:

http://ssbuv.gsfc.nasa.gov/■

Experiments flying on SEM's first flight include CAN-DO's Gravity & Acceleration Readings, Bacteria-Agar Research, Crystal Research and Magnetic Attraction; Surface Tension from Glenbrook North High School; Fluid Thermal Convection from Purdue University; Fluid Mixing from NORSTAR Student Research Center; and Bacteria Inoculation from Poquoson Middle School. Seeds, soil, tubers, Dahlia bulbs, chalk, crayon, calcite, Silly Putty, bubble solution, popcorn, mosquito eggs, and other organic compounds will also fly aboard SEM as passive experiments sponsored by Hampton Elementary School, CAN-DO, Glenbrook North High School, and Purdue University.

Additional information on SEM may be accessed via the Shuttle Small Payloads Project World Wide Web Homepage at:

http://sspp.gsfc.nasa.gov ■

Is this Ancient Life?

4 lb. Rock Raises Host of Questions for Viking Project Scientist

by Dr. Gerald Soffen

This August, a NASA research team of scientists announced that they had found evidence strongly suggesting primitive life may have existed on Mars more than 3.6 billion years ago. The team found the first organic molecules thought to be of Martian origin inside of an ancient Martian rock that fell to Earth as a meteorite.

Ironically, this news was announced on the heels of the twentieth anniversary of the Viking Mars Landing. Former Viking Project Scientist, Dr. Gerald Soffen, remembers the thrill of early Mars exploration and reflects on the significance of this major planetary discovery unearthed in our own back yard.

1976. Viking Instrument Manager Al Diaz briefs Soffen.

Wow - FANTASTIC. Mars Rock with possible microfossils inside! I have to pinch myself to make sure I'm not dreaming. All my adult life I have been thinking about the origins of life (on the Earth). I joined NASA to be able to search for life on Mars. And now, right under our nose, in some dusty storage case, comes an almost miracle.

A rock from Mars formed when Mars was becoming a planet 4 1/2 billion years ago, got knocked off by a great big boulder that hit the planet 10 to 20 million years ago, and now landed on Earth at the South Pole at the dawn of civilization.

I have spent most of my life (as the Project Scientist for the Viking) searching for life on Mars and came up empty handed. Roberta Score in 1984, on a National Science Foundation expedition to the Antarctic, finds a 4 pound rock in the blue ice and may have changed scientific history.

Now, what's in this rock? For years nobody looked, and then in 1992 some folks at the Johnson Space Center discovered that the composition of the trapped gases match the signature of Mars (as measured by Viking). That discovery turned an Antarctic sample into a Martian Rock. As the team spent the next two years examining the rock, they began to turn over clue after clue, including a special Electron Microscopic picture (inset) that includes things that look like very small microfossils. Is this ancient life?

Who knows? To a biologist, it sure looks interesting. A lot of other data — organic stuff, the shapes of crystalline iron oxide granules, the appearance of segmentation — all point towards some kind of primitive ancient micro-organisms. It's too much to hope for. This could be the Holy Grail of questions about other life in the cosmos.

But what if it's only a fluke? A touch of nature to tease the cursed scientist. Ah, that's the way science and nature work!

But what if it's real. Will we ever know? Who has conceived the defining experiment? Oh, what a great time to be alive and in the middle of one of the most intriguing questions of our age. Thanks NASA for a great life.

MARS Meteorite Images Available Via the Internet:

The Internet World Wide Web URLs are:
http://rsd.gsfc.nasa.gov/marslife
http://www.jsc.nasa.gov/pao/flash
http://cu-ames.arc.nasa.gov/marslife

Back-To-School

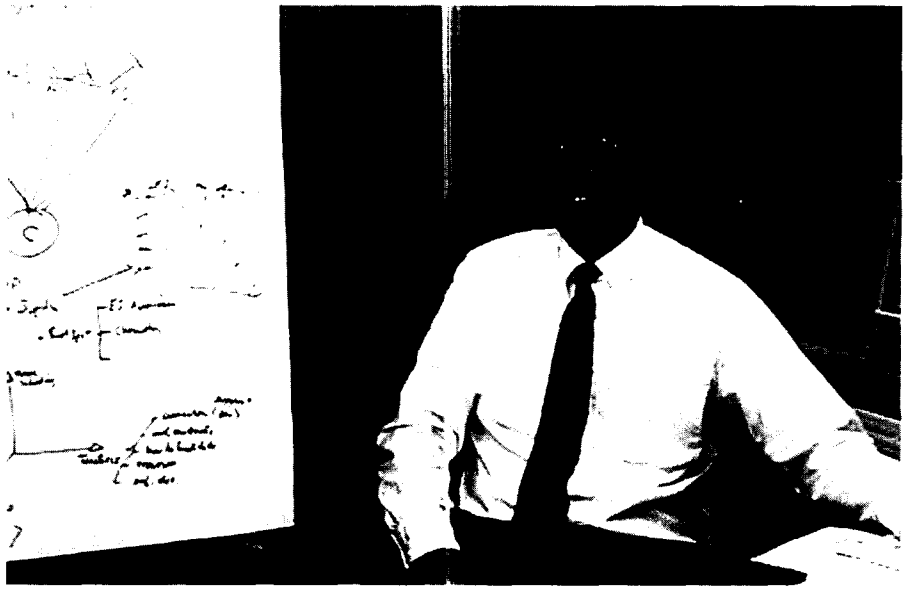
For a Lesson on Goddard's Education Office

by Dr. Bob Gabrys

Dr. Gabrys joined Goddard in April, after more than nine years with the Maryland Department of Education. In his first few months here, Bob has been a "quick study." Today, he and his staff are moving out on plans for reshaping the Center's education programs.

Since joining Goddard, I have been heartened to learn of the deep commitment to education on the part of the entire Goddard community and its talented workforce. I have seen a sincere interest in trying to improve education. The folks I have come in contact with have evidenced an interest not only in what they might do to support education within their normal jobs, but they have also given generously of themselves, volunteering personal time and resources. Everybody wants to help.

I am committed to reshaping the Education Office at Goddard to better serve the education community and to encourage the participation and support of the Goddard workforce in achieving the Center's and the Nation's goals for education. Our goal is to create an Education Office able to better serve the Goddard community in its effort to implement significant education programs for kindergarten through community college customers.



All of Goddard's education services are being relocated this fall to the first floor of building 28, bringing together all of the education services in a single location. Building 28 will house the Kindergarten through Community College staff and the Aerospace Specialists under my direction, as well as the graduate education programs under the direction of Dr. Gerry Soffen. This consolidation will enable better coordinated services.

The Education Office staff includes two teachers-on-loan—Kevin Boone of Southern High School in Baltimore City, and Elaine Lewis of Buck Lodge Middle School in Prince George's County; the five aerospace education specialists (Vern Smith, Al Byers, Dennis Christopher, Joan Sanders, Ron Ernst; and their administrative assistant Bonnie Rowell); Larry Brown (re-employed annuitant under the Partners in Education initiative); and Bowden Ward (phased retirement annuitant). Completing the staff are Lynda Matys of the Teacher Resource Laboratory, located at the Visitors Center; and summer employees Joy Claud for SHARP and Steve Korpon for the Space Scholars program.

Programmatically, the office will be organized around the 5 education components outlined in the NASA strategic plan for education, consistent with the recommendations of the National Research Council.

Goddard's Education Council, composed of representatives of the various directorates, will develop quality criteria for programs and involvement related to each of these components, and ensure that GSFC education programs are consistent with the GSFC strategic plan that is being developed.

Goddard Education Council

130	Bob Gabrys (Chair)	180	Mary Kicza
100	Jospeh Rothenberg	204	Guy Miller
100	Kathy Nado	310	Ann Garrison
110	Wayne Boswell	411	Howard Ottenstein
120	Dillard Menchan	500	Richard Tagler
130	Janet Ruff	681	Richard Fahey
150	Sherry Platt	700	Nancy Patton
160	Gerald Soffen	800	Arnold Torres
170	Nahid Khazenie	910	Richard Hartle

Undergirding the entire structure are plans for evaluating programs focusing not only on descriptive information about the programs/ involvement, but also qualitative criteria. Goddard and its Education Council will work with the Agency to pilot and refine the Education Computer Aided Tracking System (EDCATS) as a NASA evaluation tool.

In order to accomplish the goals of the Education Office, liason support structures will be established with the directorates to assure linkages with the Goddard enterprises and strategic plan.

Additionally, ties with the schools in the context of the IPA program and the teacher intern program will continue, and will be strengthened in terms of the individuals from schools making direct connections between their work at GSFC and their home school and district. Those individuals who have worked at GSFC over the past 5 years would be contacted in order to re-establish linkages for the translation of GSFC science, mathematics, technology, and engineering findings into the local classrooms, and to seek advice on how to effectively accomplish GSFC's education mission.

$25.8 Million Awarded to Advance Supercomputing

Computing Advances to Overcome High Performance Bottleneck, Make Operations Ten Times Faster

by Allen Kenitzer

NASA has awarded a series of cooperative agreements valued at $25.8 million, supporting collaboration among NASA, nine investigator teams and Cray Research, Eagan, Minn., to achieve supercomputer applications ten times faster than available today.

The advances being pursued, which will provide a new understanding of the fundamental problems in the Earth and space sciences, include modeling changes in global climate and the Earth's interior, simulating the evolution and dynamics of stars, probing microgravity environments, and processing remote sensing imagery and signals.

For broader benefit, the new computer programs and documentation will be made available to the research community on the World Wide Web's National High Performance Computing and Communications (HPCC) Software Exchange at:

http://nhse.cs.utk.edu/home.html

The three-year agreements are funded through the Earth and Space Sciences (ESS) Project of NASA's HPCC program.

Science advances will be enabled by a 384-processor CRAY T3E supercomputer being placed at Goddard as part of a $13.2 million agreement with Cray Research.

"With 49 billion bytes of memory and 230 billion floating point operations per second at peak performance, this system will be NASA's leading testbed for scalable parallel computing, in which a program's speed increases proportionally with the number of processors," said James Fischer, ESS Project Manager. Cray Research subsequently will assemble a CRAY T3E as large as 1,024 processors to allow 100 billion floating point operations per second sustained on investigator applications.

"This effort will further the Earth and space sciences by helping to overcome one of high-performance computing's greatest bottlenecks — the lack of usable software for parallel machines," said Lee Holcomb, Director, Aviation Systems Technology Division at NASA Headquarters, Washington, D.C. "Such computational studies strongly mesh with NASA's observational and theoretical programs and contribute to our wider mission of scientific research and space exploration."

Additional ESS Project information and details on the specific investigations may be obtained on the World Wide Web at the URL:

http://sdcd.gsfc.nasa.gov/ESS/ ■

Ten Fellows Chosen From Goddard

by Mark Goldman

Ten outstanding individuals have been selected from Goddard to participate in the 1996-1997 Council for Excellence in Government (CEG) fellows program. This year's class of ten Goddard fellows will be the largest group to represent the Center since the agency began nominating participants for the government-wide program in 1991. The CEG fellows program is an intensive, year-long leadership development opportunity to build the capacity of mid-level federal managers to lead organizations that get results. As part of their fellowship year, this year's participants will develop strategies for meeting the complex challenges facing their organizations.

Throughout the year, Goddard's fellows will meet with Council Principals, Government Executives, and other public and private sector leaders who have successfully led results-driven organizations in government and business. Fellows will also visit benchmark companies and government organizations around the country to see first hand how they are managing for results in their organizations. Among the potential site visits are: Transamerica Corporation, Eastman Kodak Company, Federal Express, Export-Import Bank of the U.S., and our own Goddard Space Flight Center.

In addition to site visits, Fellows will attend workshops where they explore in-depth the qualities that define effective leaders and effective leadership in organizations. They will look critically at their own leadership challenges and develop "how to" strategies for making leadership choices, taking action, and, ensuring results."■

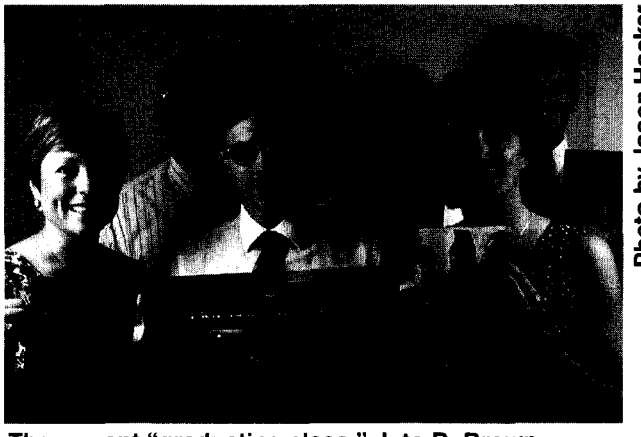


Photo by Jason Hacker

The current "graduating class." L to R: Brown, Robinson, Paprocki, Pine, Buck, Fitzgerald

The 1996-1997 Goddard Fellows		"Graduating" 1995-1996 Goddard Fellows		Goddard CEG Alumni Since 1991	
200	David Moulton	130	Cindy Buck	150	Nancy Abell
	Bradley Poston	153	Dona Vance	110	Wayne Boswell
	Deborah Sharpe	200	Karen Flynn-Newlon	200	Kelly Carter
	Pradeep Sinha		Phillip Holloway		Krista Paquin
300	Ron Chinnapongse		Thomas Paprocki		Mark Walther
	Louis Thomas	300	Gregory Robinson		
540	Steven A. Smith		Esmond Marvray		
700	Mary DiJoseph	400	Richard Fitzgerald		
	Martin Frederick	700	Kris Brown		
900	Mary Cleave				

dateline : Wallops Flight Facility

HOMER

NASA Launches Student Atmospheric Experiment

by Betty Flowers

An experiment to study the atmosphere, designed and built by students from several Colorado universities, was successfully launched late this summer from the NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Va.

The High Altitude Ozone Measuring and Educational Rocket (HOMER) was launched under the NASA Student Launch Program. The program provides undergraduate students practical, hands-on experience in the development of scientific suborbital payloads.

Ellen Riddle, co-project manager from the University of Colorado at Boulder said "the program provides good insight into working on projects. It gives the student enormous experience in payload development and working as a team." In the classroom, individual effort is the focus, while on the project, teamwork is the focus, according to Riddle.

Riddle, a graduate student, said 50 students from four Colorado universities have worked on the project since March 1995 under the Colorado Space Grant Consortium. The schools included the University of Colorado at Boulder, Colorado State University, the University of Colorado at Colorado Springs and the University of Colorado at Denver.

HOMER was the third atmospheric experiment flown by Colorado students since 1992. Each of the payloads has advanced in complexity. Riddle said, "we learned a lot about preparing missions from the last mission in 1994. Those lessons-learned were incorporated into this mission. This payload is more sophisticated with more advanced science instruments and data support systems," she said.

Wallops provided technical guidance, rocket motors and hardware, recovery system and launch support for the mission. The Colorado Space Grant Consortium provided the telemetry system and science instruments.

The 1992 Colorado mission was a pilot project of the Student Launch Program. In addition to the 1994 launch and the one today, two scientific balloons were flown in 1995 and another sounding rocket mission is scheduled for 1997.

The Student Launch Program is sponsored by the Office of Space Science, the Office of Human Resources and Education, and Office of Equal Opportunity at NASA Headquarters, Washington, D.C.■

Subscription Information:
GSFC & WFF Mailing List
Offsite/Commercial Subscriptions
Retiree Subscriptions

Contact:
Gweny Durrah
Darlene Ahalt
Bob Wilson (301/422-8334)

Goddard NASA

The GODDARD NEWS is published monthly by the Office of Public Affairs, Goddard Space Flight Center, Greenbelt, MD 20771

Deadline to submit material is the first of each month. For additional information contact C. A. Buck (301) 286-7646.

The GODDARD NEWS Staff is:
Executive Editor: Jim Sahli
Acting Managing Editor: C.A. Buck
Senior Photographer: Mark DeBord
Contributing Editors: Tammy Jones, W. Allen Kenitzer, Denise Konopka, Bob Gabrys, Betty Flowers, Mark Goldman.

Continued from Page 1

The NASA Goddard-developed program has been extremely successful, playing a vital role in saving lives. This earlier program evolved into today's Search and Rescue Satellite-Aided Tracking (SARSAT) System. This system provides for location of both old-technology ELT and the new technologies available.

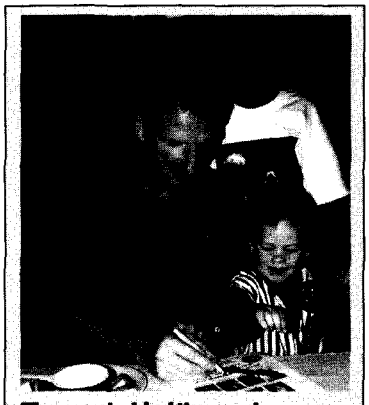
NOAA now operates the space and ground segments for the United States. Internationally, the system is known as COSPAS-SARSAT. Some 28 nations now participate in the program and provide both ground and space segment equipment. The satellite system has contributed to saving more than 6,000 people in aviation and maritime incidents since its introduction in 1982.■

National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland / Wallops Island, Virginia

November 1996 Vol. 43 No. 19



The man behind the mask, Joe Tanner.

Goddard is responsible for managing Hubble servicing, overseeing the development of replacement instruments, and designing special tools to be used during the mission.

Mission Profile

Vehicle: Discovery
Mission number: STS-82
Primary payloads: NICMOS/STIS
- Near Infrared Camera and Multi-Object Spectrometer
- Space Telescope Imaging Spectrograph

Astronauts: 7
Mission Duration: 10 days, 4 EVA's scheduled
Launch schedule: Feb. 1997

Background
Deployed: Apr. 1990
Servicing Mission 1: Dec. 1993, STS-61, Endeavour

Hubble Second Maintenance Mission

Crew
Ken Bowersox, Comander
Scott Horowitz, Pilot
Mark Lee. Payload Commander
Greg Harbaugh, Mission Specialist
Steve Smith, Mission Specialist
Joe Tanner, Mission Specialist
Steve Hawley, Mission Specialist

Hands Like A Surgeon

Hubble astronaut, Joe Tanner, stays focused on his task, working with the precision and dexterity required to handle Hubble's delicate replacement instruments. Tanner and his fellow second servicing mission astronauts practiced in Goddard's building 29 cleanroom with Hubble replacement hardware. The STS-82 crew have visited the Center several times this fall in preparation for next year's house call to Hubble. While visiting, the astronauts took time out from their busy practice schedule to socialize with members of the Goddard project and their families. The Hubble team also spoke to Goddard employees about plans for their February mission during a special colloquium held this fall.

"1776" to 1996 - Anyone for a Congressional Reenactment?

by Mike Harris

Hear Ye All Patriots! All persons bearing witness to the tyranny of King George within these Continental Colonies — Your presence is requested at the First Continental Congress in the township of Philadelphia. Issues at hand: Royal tariffs & taxes, German mercenaries in kilts, and the irrepressible Benjamin Franklin dancing rings around Congress with the 'obnoxious and disliked' John Adams.

You may recognize someone you know...

You are hereby invited to the 220th birthday celebration of this great nation. This year's party, presented by Goddard's Music and Drama (MAD) company, is "1776".

Goddard's theater production team takes you back over 200 years, and sports statesmen, lawyers, ministers, wives of the congressional delegates, and General George Washington's own courier. By traveling back to the scene of the Declaration, and watching the Congress in action, we are reminded that those we tend to think of as serious historical figures, memorialized in marble and granite, were actually people as full of human frailty and foible as we are.

Benjamin Franklin, played by Goddard's own ***Jerry Simpson***, Director of Human Resources cuts a rug and exchanges verbal musketshot with the likes of John Adams, played by ***David Quinn***, Guidance-Navigation-Control engineer.

"1776" has a large cast of characters, well represented by Goddard employees across the center. You may recognize someone from your own organization ...***John Degnan***, physicist, as John Dickinson; ***Bill Struthers***, electrical engineer, as the 'other' Ben

"Common Sense" Head of Human Resources is Ben Franklin

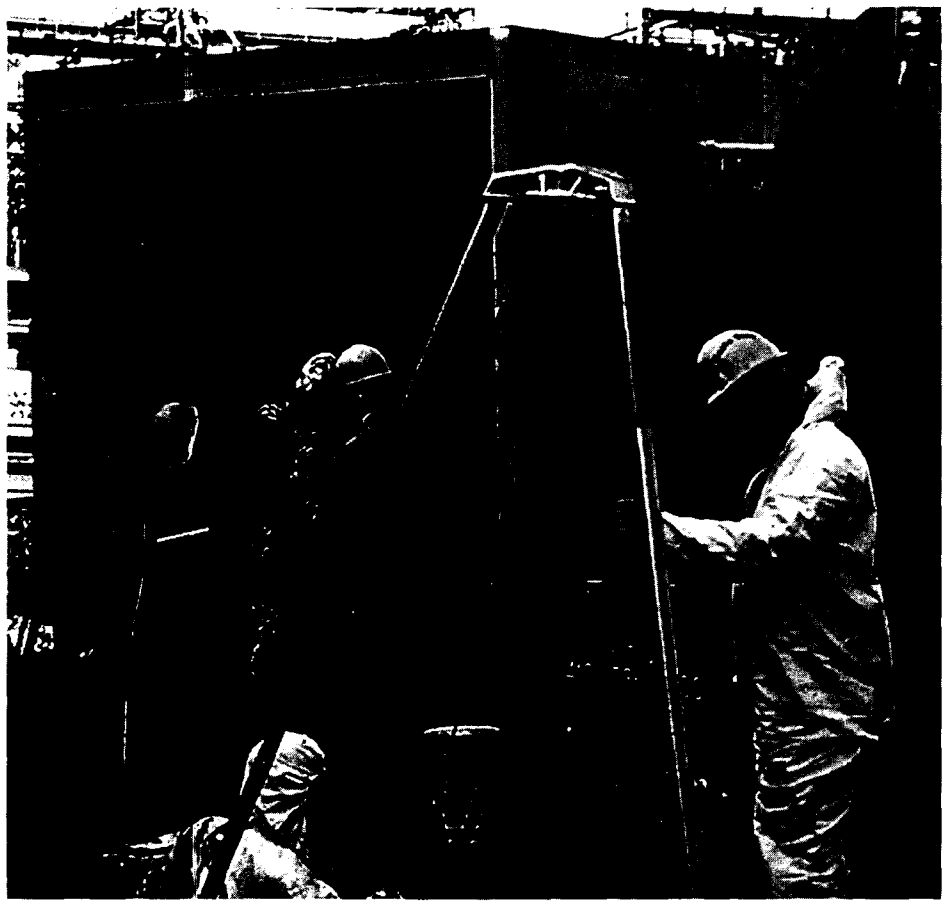
Continued on Page 7

EMT Group 'To the Rescue'

It may have been "only a test," but the more than 50 members of the Emergency Management Task Group and their colleagues were deadly serious during their emergency preparedness simulation held at Goddard this September. Personnel from the Safety, Environmental and Security Office; the Facilities Management Division; Logistics Management Division; and Public Affairs participated in an all-day simulated drill in which a fictitious fuel oil truck spilled its 7,000 gallon cargo into the storm drains at the intersection of Delta and Tiros roads.

The real-life Goddard emergency team worked alongside the Emergency Management Task Group, NASA Headquarters, Prince Georges County Fire Department, and Prince Georges County Office of Emergency Preparedness to put Goddard's newly developed functional plans for communications, public affairs, logistics, and resource management to the test.

Goddard's Emergency Preparedness Coordinator, ***Phillip Tapper***, said the dress rehearsal was extremely successful, and explained that lessons learned from the day of battling a mock fuel spill, radio system glitches, and other contingencies would be incorporated in the Center's future emergency planning.



Progress on Process

SEWP-II Speeds Computer Purchases

This month's entry features Goddard's Scientific and Engineering Workstation Procurement (SEWP-II) selections announced in October. NASA has awarded contracts worth $1.8 Billion for purchasing UNIX-class workstations, networking equipment, super computers and computing peripherals. SEWP-II enables Goddard, NASA and other government agencies to purchase computing equipment at the best possible price. SEWP-II also reduces the procurement processing time for small purchases by an estimated factor of eight or better. Small purchases that once required months to process will be completed in a matter of days. In the case of larger purchases, the resulting impact is even greater. Procurements that would have typically required more than a year to complete may now be accomplished in as little as five working days. By re-engineering business and procurement practices, work is accomplished by fewer people in less time, at greater savings. SEWP-II makes buying computing power faster, better and cheaper than ever.

SEWP-II is the follow-on program to Goddard's highly successful SEWP-I initiative instituted in 1992. SEWP-II builds upon the general principles pioneered and tested with SEWP-I , expanding on the original program's scope and increasing the number of eligible participants.

Submit your best examples of impacts and achievements resulting from Goddard's process improvements and re-engineering efforts. If your new process is saving time or money, and/or improving service, let others know in the "Progress on Process" corner.

Space Telescope: The Next Generation

by Dr. John Mather
Space Sciences Infrared Astrophysics Branch

NASA has chartered Goddard and the Space Telescope Science Institute (STScI) to lead the study of a Next Generation Space Telescope (NGST), an orbiting observatory capable of studying the early formation of stars and galaxies at high red shift. Three teams are conducting next generation studies, with guidance that total construction costs should be no more than $500 million, and that the telescope proposed should fit within an Atlas IIAS launch vehicle. This government-led effort is managed by Bernie Seery (GSFC). I serve as the Study Scientist, and Peter Stockman leads the STScI effort in addition to co-chairing the Science Working Group. Lloyd Purves (GSFC) is the Systems Engineer and leads the spacecraft team. Pierre Bely (STScI) leads the science module team, and Jim Bilbro (MSFC) leads the telescope team. In addition, Keith Kalinowski leads an operations team, and Richard Capps leads the JPL effort. Other key figures in this activity are Rob Kennicutt, the chair of the Science Advisory Committee reporting to the head of the Origins Program at NASA Headquarters, Ed Weiler.

There also are two industrial consortia, selected to do completely independent studies. The TRW team is led by Dr Chuck Lillie, and the Lockheed-Martin team by Domenick Tenerelli.

Work on a future passively cooled telescope to study stars and galaxies in the infrared is the direct result of recommendations made by the "Hubble Space Telescope (HST) and Beyond Committee," chaired by Alan Dressler. This committee recognized the enormous scientific capabilities of a large-aperture, infrared-optimized space telescope, and recommended strongly that such a mission be developed to follow the HST and Space Infrared Telescope Facility (SIRTF) programs. The Committee identified the scientific requirement for such a telescope and listed a wide range of scientific research which would be enabled in both the optical and far infrared.

Based on our work to date, it appears possible to build a deployable telescope of the order of 8 meters in diameter. The telescope would be placed in an orbit far from Earth, like the Lagrange point L2, or a solar drift orbit like SIRTF, so that it could cool to around 30 K by radiation.At that temperature, special detector arrays could cover the desired wavelength range without additional cooling. With some additional effort, hydrogen and helium coolers could enable the use of special silicon detectors for broader wavelength coverage.

The NGST will demand careful use of new technology. The deployment of a lage mechanical structure to hold up the mirrors requires great care in design.The mirrors will have to be adjusted after launch, and to achieve a low enough weight they will have to be very thin. New materials and processes make this possible, and there is a wide range of choices. Researchers like RogerAngel of the University of Arizona are beginning to tackle many of the technical challenges with important technical and engineering demonstrations. This is the first step in the proof that adjustable mirrors in space can enable orders of magnitude improvement in capability It is a tremendous challenge and a tremendous opportunity.■

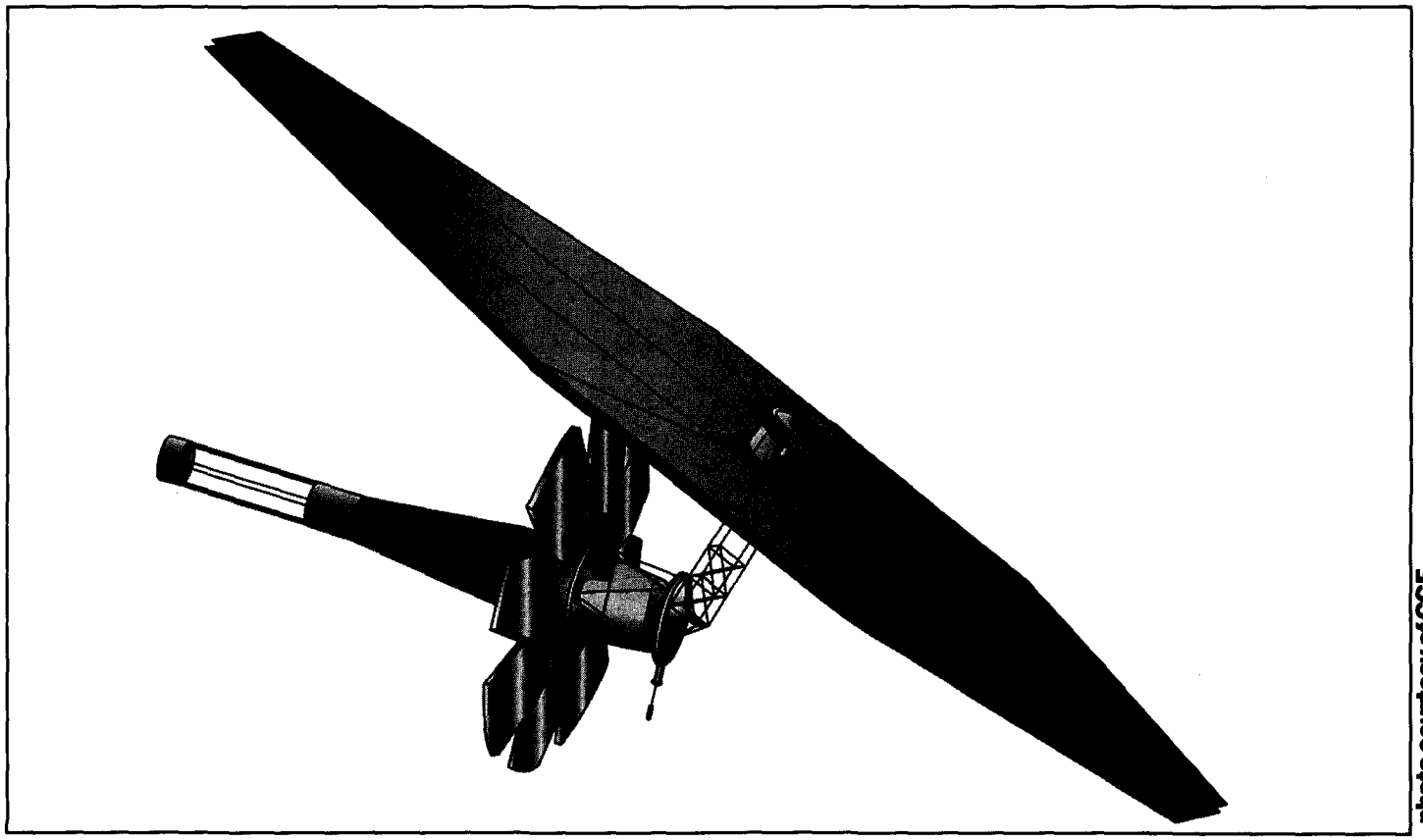


photo courtesy of CGF

Artist concept: Next Generation Space Telescope

A Century of Progress:

Goddard Contributions in Geology and Geophysics

by Dr. Paul D. Lowman Jr.
Earth Sciences Geodynamics Branch

The end of a spectacular century is approaching and the dawn of the 21st Century is here. As a tribute to Goddard's great scientific contributions, Dr. Paul Lowman in the Geodynamics Branch of the Laboratory for Terrestrial Physics, compiled a list of the things he believes to be the 12 most important discrete discoveries in geology and geophysics since 1900. Lowman's work is in press for the November issue of The Journal of Geoscience Education, the country's leading geological education journal. Below is a select summary of the geological discoveries. Items that only a geologist could love, such as overthrust faulting, have been omitted.

The most fundamental discrete discovery in geology and geophysics since 1900 was the radioactive decay law formulated by Rutherford and Soddy in 1902. Their experiments at McGill University produced a differential equation for radioactive decay that became the foundation for radiometric dating, calculations of the Earth's age, and many other applications including the thermal evolution of planets, studied by Gordon MacDonald while at Goddard in 1960. However, several later key discoveries arose largely from space research.

A 'Who's Who' account of Goddard Scientists, past and present, who have blazed the trails for Earth sciences and planetary geology and geophysics.

Sea-floor spreading was first proposed by Harry Hess of Princeton University in 1962. Sea-floor spreading rapidly became an accepted theory due in part to Goddard's ***Jim Heirtzler*** when he was at Columbia University in the mid-1960s. Heirtzler developed a chronology for sea-floor spreading from the magnetic reversal pattern, and later explored spreading centers himself in the Alvin submersible. Sea-floor spreading has now been directly demonstrated by the space geodesy techniques of the former Goddard Crustal Dynamics Project, headed by ***Bob Coates*** and ***Dave Smith***, current Chief of the Laboratory for Terrestrial Physics.

The field of space geodesy itself was founded by ***John O'Keefe***, recently retired from Goddard, who in 1955 proposed using satellites for geodetic measurements. Satellite laser ranging and very long baseline interferometry (to which ***Tom Clark*** has made major contributions) have now produced a geodetic *tour de force*, showing that because of sea-floor spreading several islands in the Pacific Ocean are moving away from the East Pacific Rise at several centimeters per year. Australia, an example of continental drift as a consequence of plate movement, also appears to be moving northward. Movement along the San Andreas Fault system, part of the Pacific-North American plate boundary, has similarly been measured over several hundred kilometers by space geodesy.

Impact cratering has been very much in the news since Shoemaker-Levy-9 bombarded Jupiter. Scientists now realize that similar impacts, have had catastrophic effects on the Earth, including the extinction of dinosaurs. Goddard scientists played a key role in crater studies in the mid-1960s. Nick Short and Bevan French, of the former Planetology Branch, developed petrographic criteria for recognizing shock-metamorphosed minerals, and organized an international meeting at Goddard in 1966 that founded a new branch of geology: impact metamorphism.

French also demonstrated the impact origin of the Sudbury Structure, a 60 by 30 km nickel-bearing basin in northern Ontario. We have continued the Goddard-Sudbury connection with radar mapping, where I was privileged to work with Herb Blodget and Penny Masuoka, in cooperation with the Canada Centre for Remote Sensing. Herb Frey continued this important work, demonstrating the broad application of impact concepts by showing that the first ocean basins may have been formed by impacts analogous to those that formed basins on the Moon, Mercury, and Mars.

High Impact! Our Moon's 'Sea of Rains,' Mare Imbrium, features impact cratering. Photo courtesy of Mt. Wilson Observatory.

Lowman shows Stone Age tool found with Space Age technology. Ancient stone axe retrieved from Egyptian desert by U.S. Geological Survey with the help of 1981 NASA Shuttle Imaging Radar mission, SIR-A.

Common patterns of planetary differentiation for the Moon, Mercury, Mars, and perhaps Venus and Earth, have been deduced from various Goddard projects. John O'Keefe and Wini Cameron (now retired) proposed as early as 1962 that the Moon was differentiated, applying the petrologic studies by Lou Walter, current Associate Director of Earth Sciences at Goddard. This was soon demonstrated directly by an Apollo X-ray fluorescence experiment, led by the late ***Isidore Adler*** of Goddard, and by gamma ray spectroscopy, in which ***Jack Trombka*** is still active. Adler also headed a Goddard Apollo sample analysis team that arrived at a similar conclusion. ***Rudy Hanel's*** IRIS team on Mariner 9 found evidence in 1972 for differentiation on Mars. Again, I was fortunate to work with Goddard staff members, including ***John O'Keefe***, ***Bill Kaula*** (formerly of the Theoretical Division), and ***Herb Frey*** — this time to produce broad theories of planetary evolution.

Goddard's past and ongoing role in this Century of Progress shows clearly that space sciences and earth sciences are closely coupled, and that the exploration of space has also been the exploration of Earth.■