NASA
National Aeronautics and Space Administration
Goddard Space Flight Center

Goddard News

Greenbelt, Maryland and Wallops Island, Virginia

Vol. 30 No. 10 October 15, 1983

CFC drive begins

Goddard began its support of the 1983-84 Combined Federal Campaign (CFC) October 11. Center Director Noel W. Hinners (second from right) pledges Goddard's support to helping others in need. Shaking hands with Hinners is CFC Loan Executive William Kelly. From left: Stephan Fogleman, chairman, Goddard Employees Campaign Committee and A. T. Dannessa, co-chairman. This year's goal, established by the committee, is $215,000.

Goddard developed refrigeration system wins I-R 100 Award

A new refrigeration system developed by NASA to cool instruments aboard satellites has received the prestigious I-R 100 award from Industrial Research and Development Magazine. The Magazine has named the invention, known as the Stirling Cycle Cryogenic Refrigerator, as one of the 100 most significant technological advances of 1982.

The refrigeration system was developed by engineers at Goddard and North American Philips Laboratories in Briarcliff Manor, N.Y. John Boeckel, Goddard's Director of Engineering, will receive the I-R 100 award for Goddard.

The award recognizes the new cooling system for innovations and improvements in Stirling cycle closed loop refrigeration design that permit cooling to 5 watts, or 65 degrees K (-343 degrees F).

An additional I-R 100 award has been directed to the Philips Corporation for developing (under NASA contract) frictionless linear magnetic bearings to give refrigerator components longer, wear proof lives that are less susceptible to failure. The bearings are the first application of magnetic bearing technology to reciprocating (or piston type) machinery such as pumps and compressors. Known as Reciprocating Magnetic Bearings, they could be a precursor to future development and use of similar bearings in non-space applications, for example, pumps, motors, compressors and other mechanical devices. The linear magnetic bearings are electronically controlled, and replace

Continued on page 5

TDRS-1 relocation initiated

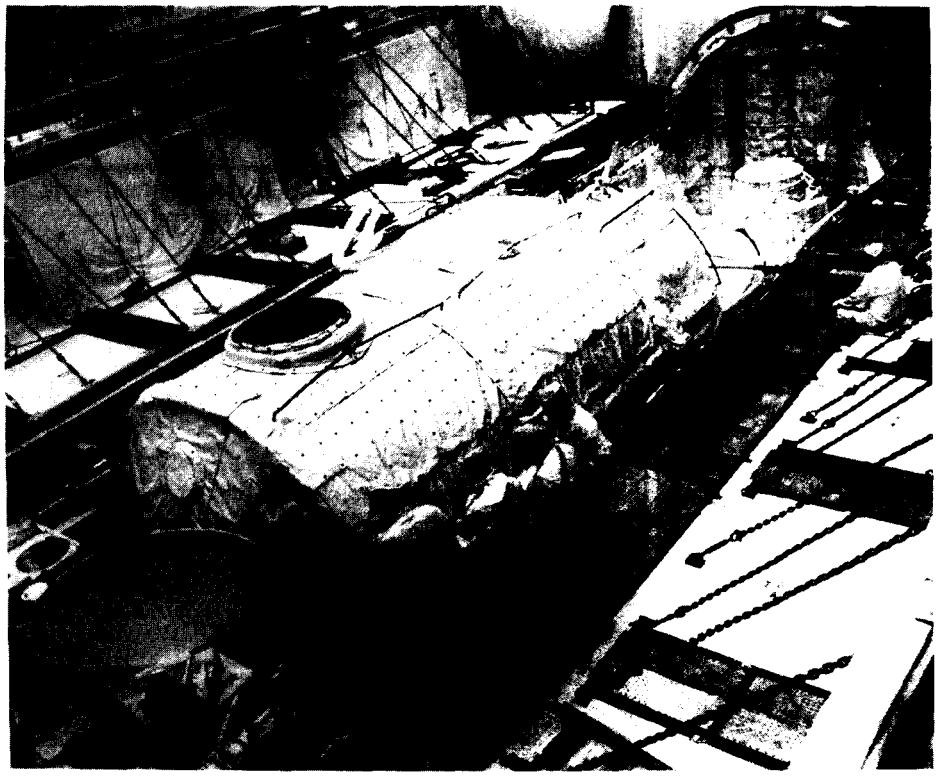
A NASA-industry team of engineers successfully staged two maneuvers late last month to relocate the Tracking and Data Relay Satellite, according to Goddard officials.

Using six tiny thrusters on the communications spacecraft, engineers from Goddard, from SPACECOM, and from TRW conducted two burns to start the movement of the satellite from 67 degrees to 41 degrees west longitude.

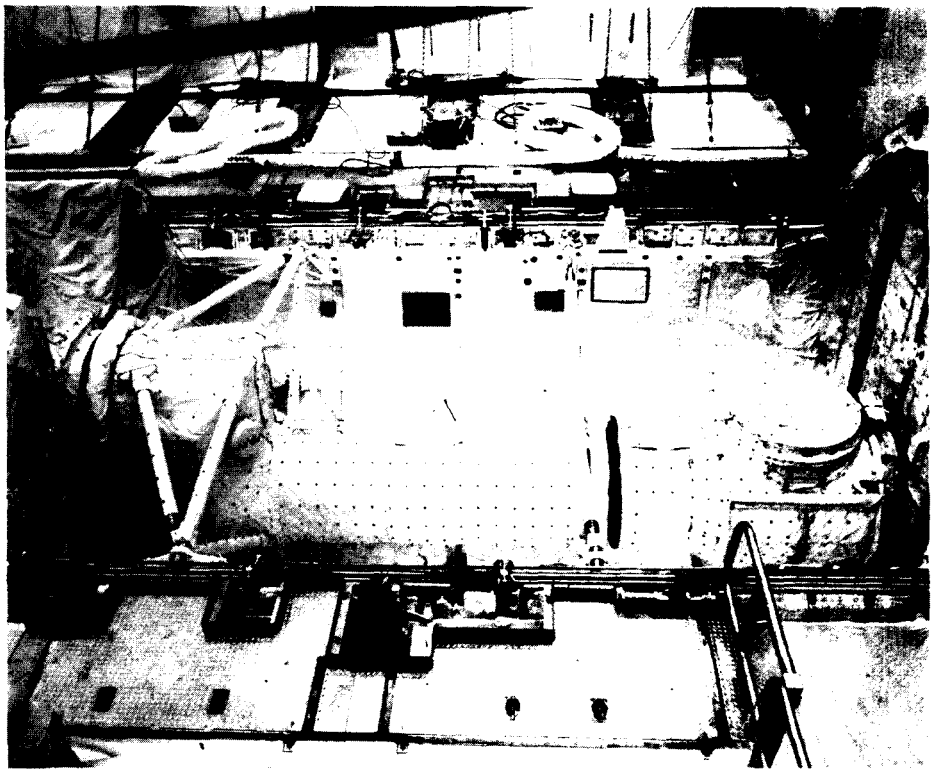
The burns will permit the spacecraft to drift at a rate of 1.2 degrees until the thrusters will be fired again on October 16 and 17 to halt the drift at its permanent position, over the Atlantic just off the east coast of Brazil.

The spacecraft was launched from the Space Shuttle Challenger last April. Because of a failure in the booster rocket, the satellite failed to reach geosynchronous orbit. The engineers, using delicate maneuvers over a 58-day period, finally got the spacecraft into a circular orbit on June 29. Since that time, the engineers have been conducting tests and evaluation with the spacecraft, having worked with the Landsat 4 Earth resources satellite and the STS-8 Shuttle mission in preparation for supporting the STS-9 Shuttle mission and Spacelab 1.

STS-9/Spacelab I Mission



Technicians inspect the European-made Spacelab installed in the cargo bay of the orbiter Columbia before Spacelab's maiden flight on STS-9, scheduled for a nine-day mission. The Spacelab I mission uses the double habitable module for astronaut experiments, and a single experiment pallet, (left) for instruments which must be exposed to space.



The Spacelab access tunnel is the only major piece of Spacelab hardware made in the United States. It allows astronauts to travel between the orbiter crew compartment and the Spacelab in shirt-sleeve conditions. The airlock adapter (right) allows access to space, should an extravehicular activity become necessary during the mission.

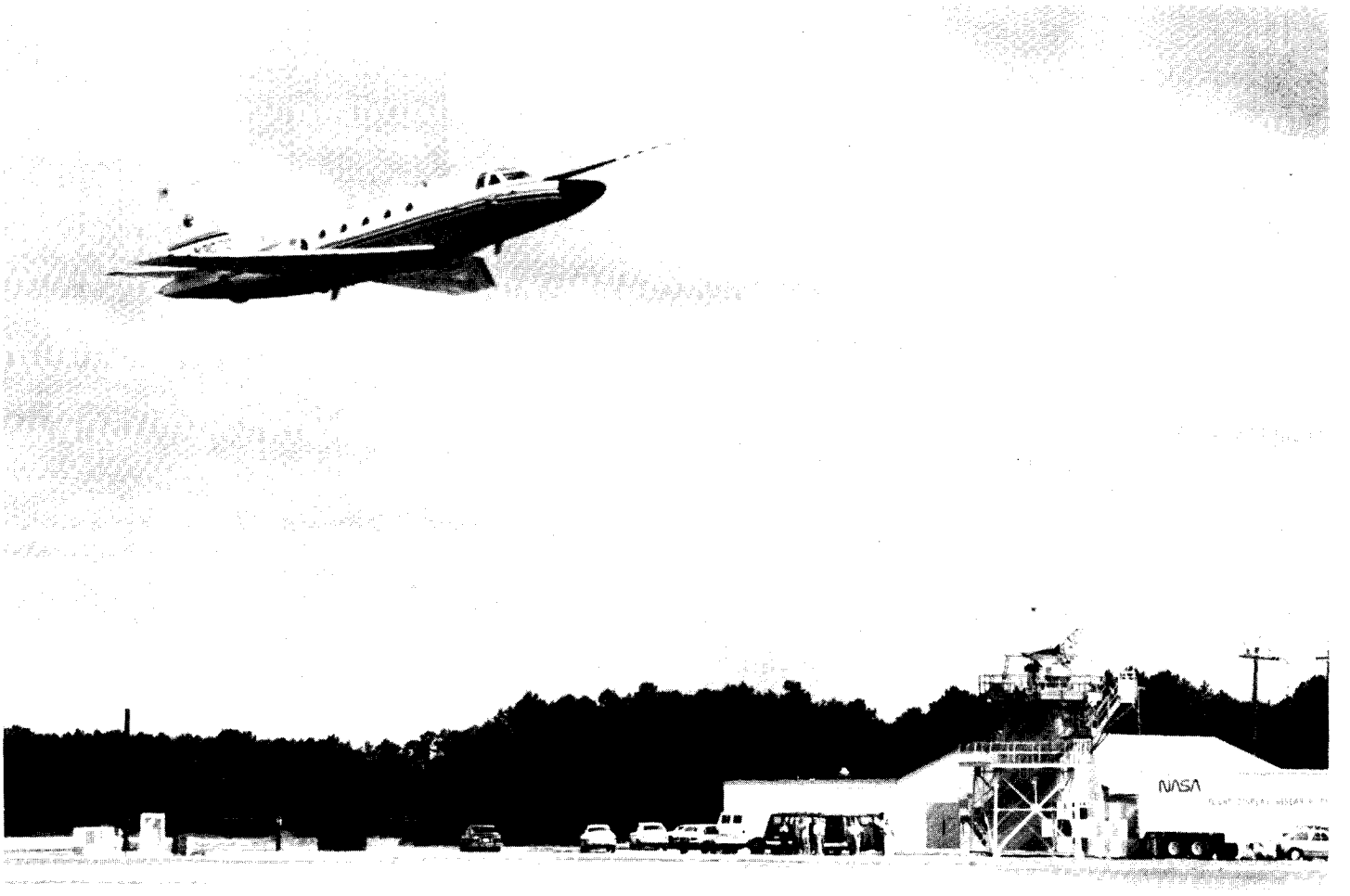
The STS-9/Spacelab I mission marks the return of the Space Shuttle Orbiter Columbia. Columbia was used for the first five Space Transportation System mission in 1981 and 1982 and will carry the largest crew (six members) to date. STS-9 is also scheduled to be the longest mission to date. Columbia is scheduled to carry Spacelab and its four-member NASA/ESA payload crew into orbit for a nine-day verification and science mission. More than 70 individual investigations in five research areas will be performed during the mission.

Think about it. . .

Great discoveries and improvements invariably involve the cooperation of many minds. I may be given credit for having blazed the trail, but when I look at the subsequent developments I feel the credit is due to others rather than to myself.—Alexander Graham Bell.

NASA, FAA work on Vertical Separation Program

could lead to change in air traffic control system structure



The Sabreliner is tracked with a Wallops C-band precision radar while flying several altitudes on a jet route close to Wallops. This maneuver, part of the NASA/Federal Aviation Administration's Vertical Separation Program, provides a relationship between barometric pressure altitudes, which aircraft fly, and their corresponding geometric heights, which vary with changing atmospheric conditions.

NASA and the Federal Aviation Administration (FAA) are working on a project which could cut domestic jet fuel costs and improve the efficiency of FAA operations. Called the Vertical Separation Program, the project is the first step toward a change in the air traffic control system structure.

The change is a reduction in the high-altitude vertical separation standard - or minimum vertical distance between two aircraft. This distance must be flight planned if the airplanes are expected to be close in the horizontal plane.

Currently, the minimum required vertical distance is 2,000 feet. Both the FAA and airspace users would like to see a 1,000 foot standard implemented. Before a reduction can occur, however, safe air traffic control operations must be assured and system performance standards must be developed to support the change.

Key to the safety analysis and performance standards development is knowledge of how well aircraft maintain assigned altitude when flying at 29,000 feet or higher. This height is where the current 2,000 foot minimum is required.

The FAA has a proposed methodology for collecting data on altitude maintenance which has been undergoing periodic testing and development at Wallops Flight Facility since April 1982. A five-week full-scale test of the procedure began July 12, 1983, involving a specially equipped North American Sabreliner aircraft from the National Center for Atmospheric Research Center in Boulder, Colorado; the FAA's Washington Air Route Traffic Control Center in Leesburg, Virginia; and staff from the FAA Technical Center in Atlantic City, New Jersey.

Future plans for methodology development call for Wallops' continued involvement. A possible short-term follow-up of this summer's test is tentatively scheduled for this fall at Wallops.

Also, under active consideration is a three-week, field data collection in the Denver-Boulder, Colorado area this winter using one of the Wallops mobile C-band radars. Further large-scale data collections are planned for Wallops in FY '84 and '85, once the methodology is fully developed.

Wallops Project Manager and Test Director is Raymond D. Atkins. FAA Technical Center Program Manager is Brian Colamosca and FAA Headquarters Program Manager is Jerry W. Bradley.

Storage system enables better access to larger volumes of data

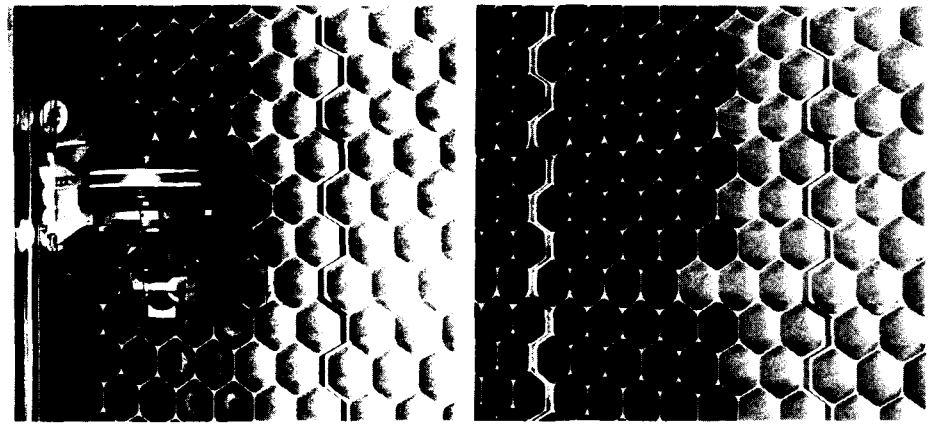
A new space-saving data storage system is operational in Goddard's Science and Applications Computing Center (SACC). The Mass Storage System (MSS) increases greatly SACC's storage capacity and provides users with better access to much larger volumes of data. Previously, users of SACC facilities lacked the convenience of direct access to their data if the data exceeded three million bytes. The total storage capacity of the MSS enables direct access to over 200 billion bytes. The SACC is a large, multi-purpose computing center which supports scientific research at Goddard.

The MSS upgrades SACC operations two ways: First, much larger volumes of data are accessible, in an interactive mode via terminal, to researchers than before. Second, when the MSS is used instead of tape in the batch mode, the manual process of finding, mounting and refiling tapes is eliminated and turnaround time is reduced.

The MSS has yet another advantage. It requires less space than the conventional disk storage units which it supplements. The MSS resembles two giant honeycombs facing each other and occupies about 70 square feet of floor space. Conventional disk storage units of the same capacity would occupy over 2,100 square feet.

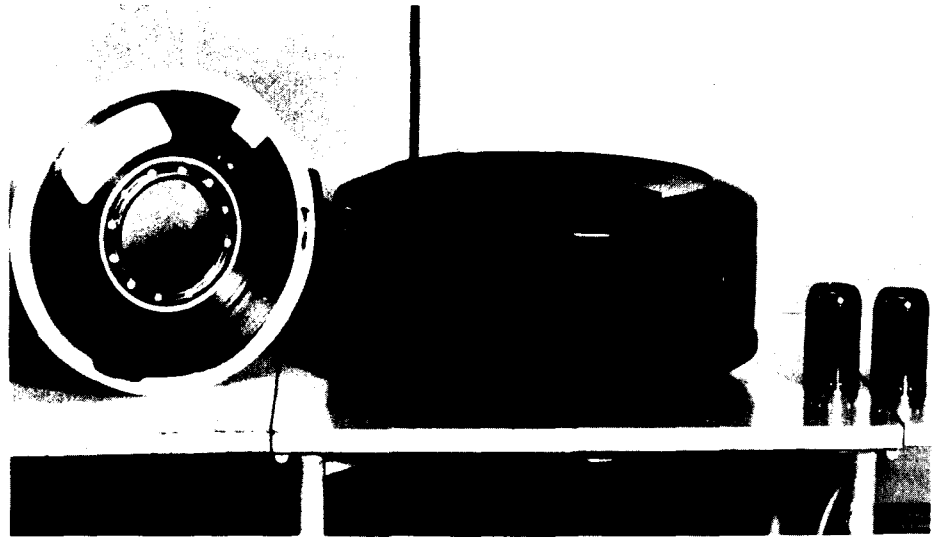
The comb-like storage units employ two robot arms (see photo) which extract, read, write and return 4700 data tape cylinders stored in the cells of the honeycomb. Each tape cylinder stores 50 million bytes of data, which is approximately twice the amount of information in a thick phone book.

Convenient data storage is important to researchers because it determines how fast they can get their data. Before the MSS arrived, data sets larger than three million bytes were stored on tape and processed in batch jobs, frequently overnight. Batch processing can be a long process, especially when each step in the analysis of an experiment depends on prior results. The MSS allows users with much larger data sets to manipulate their data directly via terminal, as though the data were on disk and, when necessary, set up more productive and faster batch jobs.



Joe Walters photos

The Mass Storage System (MSS) resembles two giant honeycombs facing each other. Left: one of two robot arms the system uses to extract, read, write and return 4700 data type cylinders stored in the cells of the honeycomb. Right: view of honeycomb structure. The MSS provides users with direct access to much larger volumes of data and its more convenient to operations in Goddard's Science and Applications Computing Center.

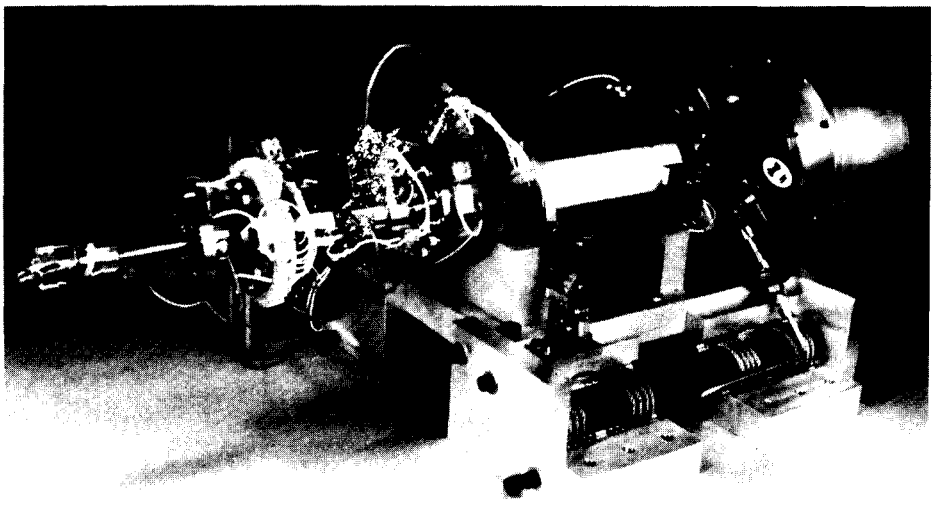


Each cylinder tape (two are shown at right) stores 50 million bytes of data, approximately twice the amount of information in a thick phone book. Two cylinder tapes hold as much information as one tape (1) or disk (m).

Another principal use of the MSS is the reduction of handling and filing of tapes in batch processing. Currently, SACC operations personnel mount, dismount and file up to 1000 tapes per day in a large tape library. This manual, labor-intensive operation has not benefited much from revolutions in computer technology over the last 20 years. The MSS offers an automated version of tape operations which, while not presently capable of replacing tape entirely, can slow the growth rate of tape libraries and tape handling.

refrigeration system

Continued from page 1



The new cooling system developed by engineers at Goddard represents a technological breakthrough, which could lead to the commercial development of pumps, motors, compressors and other mechanical devices which would operate virtually without mechanical wear. The system eliminates mechanical linkages and makes use of electronically-controlled magnetic fields surrounding the piston in the compression stage and around the displacer in the expansion section. The piston and displacer, which are suspended in the magnetic field move without touching the sides of their housing and, therefore, no friction is developed.

more conventional sliding or ball bearings. They overcome frictional wear by insuring components remain levitated and centered in magnetic fields and move without touching the sides of their housing.

As a total system, the Reciprocating Magnetic Bearing and Stirling Cycle Cryogenic Refrigerator could be capable of cooling satellite instruments in space for five or more years. Future generations of the device may eventually offer refrigeration levels as low as 10 degrees K, Goddard manager for the Project, Allan Sherman, has predicted.

Coolers are essential for many space-going scientific instruments, such as infrared and gamma ray detectors, whose sensors must be kept supercold to detect the faint levels of energy from distant targets.

Up to the present time, satellite-borne coolers have been limited in their lifetimes by the boil-off rate at which they expended their store of cryogens, the agents which cool an instrument's sensors.

Aerospace engineers have long sought close-looped systems which could endlessly recycle the same store of gas, and have flown a few such self-contained systems aboard satellites. However, the lifetime of even self-contained systems has continued to be limited by the wearing down of components by friction and mechanism failures.

The new cooling system overcomes these satellite refrigeration difficulties by its innovative design. The design is characterized by two linear motors, one which expands helium gas in the refrigerator to absorb the heat from instrument sensors, the other to compress the gas and reject the heat out to space.

Four electromagnet bearings surround the piston and displacer chambers and are continually adjusted in their magnetic fields via an electronics controlled feedback loop using position sensors.

An electronic controller also makes certain that the linear motors independently drive the piston in the compression stage and the displacer in the expansion section with the proper phase relationship.

While the system's developers continue to test a first engineering model of the new cooler, they also are building a second, ready-for-space flight version which could be completed in about two years. At the present time, the first model of the cooler has exceeded 3,500 hours of testing with no wear or degradation.

Sherman, along with co-developers Max Gasser of Goddard and the mechanical systems group of Philip's Laboratories, will be testing the durability of the design against launch stresses. They also plan to improve the sensitivity of the sensors that are placed on the magnetic bearings to determine the distance between the piston and wall for feedback corrections, and to make the whole system more efficient by reducing its power input 60 to 70 watts below the current level.

NASA and Philips Laboratories have applied for seven patents on cooler components, including the system as a unit. Patent No. 4,389,849 was issued on June 28, 1983 for the complete system.

Over 200 attend retiree-alumni homecoming

Over 200 people attended the Goddard Retirees and Alumni Association's (GRAA) first homecoming and "get-together" September 28 at Goddard's Rec Center. One of GRAA's founders, Roland Van Allen, said "everyone was enthusiastic about the creation of this organization."

Goddard's Music and Drama (MAD) combo provided entertainment. A slide show of MAD's production of Camelot was shown and Jack Libby's barber shop quartet performed. Alberta Moran was the mistress of ceremonies.

The GRAA steering committee reminds attendees of the first GRAA "get-together" to tell other retirees and alumni to call the editor of the Goddard News to have their names and addresses put on the mailing list. Allen said "we want everyone who might be interested to receive notice of future events."

PEOPLE

It pays to think

Employee Suggestion Award

Francis Schultz holds a certificate he received as part of his Employee Suggestion Award. At one of Goddard's loading docks, a gas meter was enclosed by protective aluminum pipes. Schultz suggested that the aluminum be replaced with steel, thereby ensuring no penetration which could result in damage to the gas meter. L- Schultz's supervisor Clifford Cobb; From right: Management Operations Director Benita A. Sidwell and Cobb's supervisor, Francis O'Grady. Schultz, Cobb and O'Grady are from the Facilities Engineering Division. Schultz also received $50 cash.

These six men represent the first crewmembers to man the Columbia when it gets reactivated later this month. The four NASA astronauts are joined by a European and MIT scientist payload specialist and the Spacelab module and experiment array for STS-9. On the front row (l-r) are astronauts Owen Garriott, mission specialist; Brewster Shaw, Jr., pilot; John Young, commander; and Robert Parker, mission specialist. Byron Lichtenberg of the Massachusetts Institute of Technology, left, and Ulf Merbold of the West Germany and the European Space Agency, stand in front of an orbital scene featuring the Columbia. Columbia was used for the first five Space Transportation System missions in 1981 and 1982.

Welcome aboard

Dr. Erik L. Mollo-Christensen

A former Massachusetts Institute of Technology (MIT) professor is now head of the Oceans and Ice Branch of Goddard's Laboratory for Atmospheric Sciences (GLAS).

Erik Mollo-Christensen was a professor of Oceanography at MIT for 10 years before assuming his new post. Prior to that, he had also served as professor of Meteorology and of Aeronautics at MIT. Mollo-Christensen joined the GLAS September 4.

Mollo-Christensen's research interests include applications of remote sensing techniques to ocean studies, microscale ocean dynamics processes, and air-sea interactions.

In remote sensing applications, he established the methods of using shear wave structures along the Gulf Stream to infer velocity; he also established methods for using the internal wave patterns to estimate upper ocean heat content.

In air-sea interactions, he proposed wave-coupling as a mechanism for wind wave development. All of these ideas are becoming useful tools for research and being actively studied by other investigators, according to Dr. David Atlas, chief, GLAS.

Mollo-Christensen is also involved in the multi-institutional Northeast Area Remote Sensing System (NEARSS) Program and the multi-national Marginal Ice Zone Experiment (MIZEX). MIZEX is a comprehensive program that attempts to understand the processes which control interactions between the atmosphere, sea ice, and oceans in the northern hemisphere.

A native of Norway, he received his Sc.D. at MIT in 1954 and was a Senior

PEOPLE

Astronaut Franklin Ramon Chang Diaz talks to Madeline Butler during a recent visit to Goddard. Butler is Goddard's Hispanic Employment Program Manager. Chang Diaz was born in San Jose, Costa Rica. He received his BSME from the University of Connecticut and his Ph.D. in Applied Physics from MIT. He was selected as an astronaut by NASA in 1980.

Dr. George Ludwig, Assistant for Space Data Management, Office of the Chief Scientist, NASA Headquarters, spoke at Goddard last month in observance of NASA's 25th Anniversary. Dr. Ludwig, who built instruments for many of the first U.S. satellites, spoke on "Early Explorer Satellites—A Quarter Century Later."

Mollo-Christensen

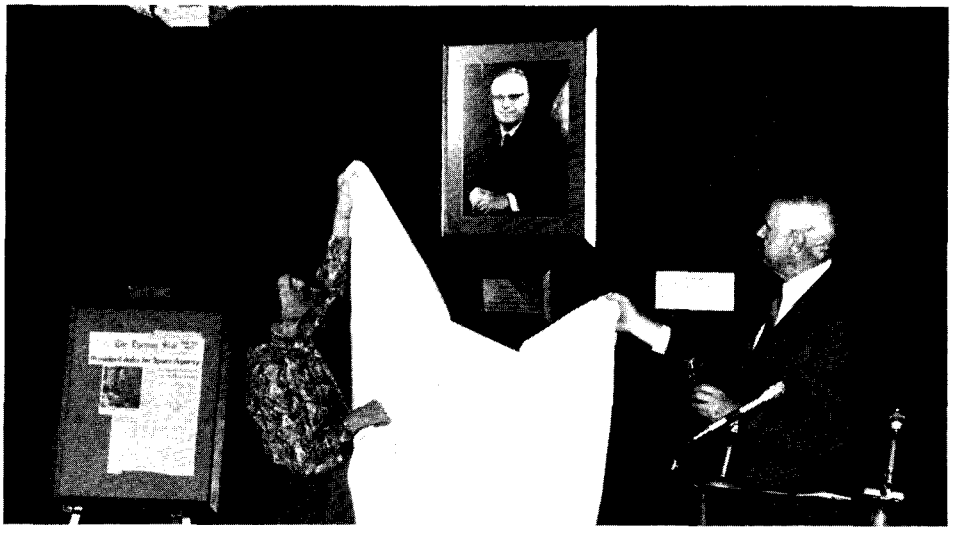
Continued from previous page

Research Fellow at the California Institute of Technology from 1957 to 1958. He served as Senior Scientific Officer of the Norwegian Defense Research Establishment at Kjeller, Norway from 1949 to 1951.

Mollo-Christensen is a member of the following: the American Academy of Arts and Sciences; the American Physical Society; the American Institute of Aeronautics and Astronautics; the American Geophysical Union; the American Meteorological Society, and the Norwegian Society of Licensed Engineers.

He has served as Associate Editor of the Journal of Physical Oceanography and as a member of the Editorial Committee of the Annual Reviews of Fluid Mechanics. He received the von Karman Award of the American Institute of Aeronautics and Astronautics in 1970.

GERMAN EXCHANGE STUDENT—Immo Holvan, an exchange from Munich, West Germany, sits at the consoles in building 14's Operations Control Center during a tour of major areas of Goddard. During his seven-week stay, Holvan lived with Dale Fahnestock, deputy director of Mission and Data Operations. Fahnestock has housed several exchange students over the years. Holvan saw all major areas of Goddard and said he enjoyed every aspect of his visit.



NASA Administrator James M. Beggs and Mrs. Homer E. Newell unveil a photograph of the late Dr. Homer E. Newell, former NASA associate administrator for Space Science and Applications. The unveiling occurred during dedications ceremonies at Goddard in honor of Dr. Newell. Goddard's library was renamed after Dr. Newell, noted for his direction of the use of space techniques for investigation of the earth, the solar system and the universe. Dr. Newell also directed the use of space technology to practical uses such as satellite weather observations, satellite communications, navigation and traffic control.

BE ALERT FOR TRICK-OR-TREATERS 'CAUSE IT'S

HALLOWEEN

October 31

Bendix selected to operate and support Goddard Laser Tracking Network

NASA has selected Bendix for negotiations to operate and provide mission support for the Goddard Laser Tracking Network (GLTN).

The cost-plus-award-fee contract would be for a base period of two years plus three one-year option periods. Total estimated value of the contract, with options, is approximately $25 million.

Republic Management Systems and Computer Services, Inc. (RMS), a minority-owned firm located in Landover, Md., has been selected as a subcontractor to support the GLTN's worldwide communications system and provide logistics. In addition, RMS will operate the network's fixed laser ranging system in Arequipa, Peru.

Under the contract Bendix will provide support to both fixed and mobile laser tracking systems which are used for precision geodetic measurements at various locations throughout the world.

The contract will call for Bendix to provide support to ten GLTN systems. In addition, Bendix will provide limited technical support and data analysis for the foreign laser network which works with NASA in studying the earth's crustal dynamics. The laser network will consist of six mobile systems, three transportable systems, and a fixed station in Arequipa, Peru.

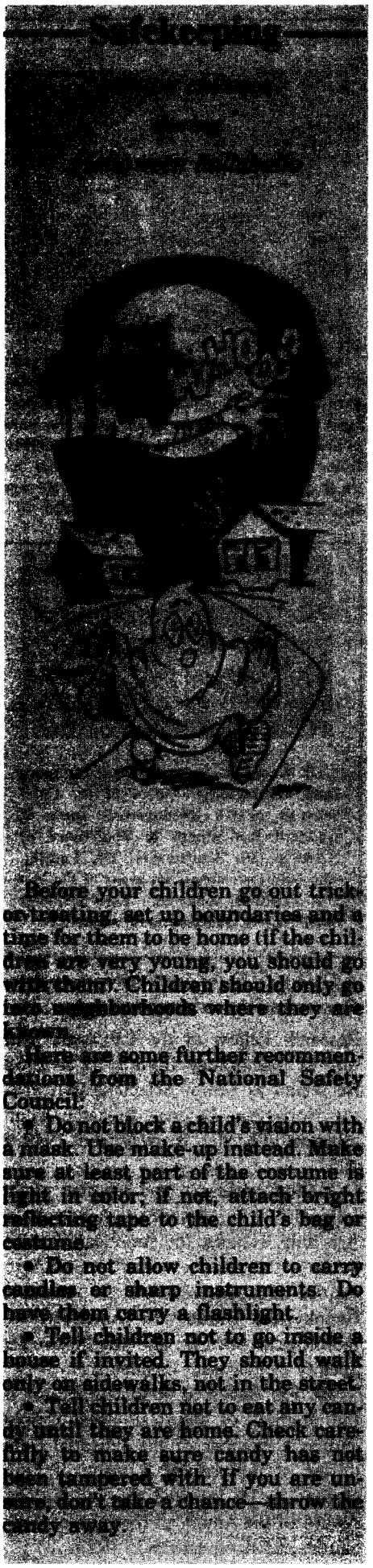
Bendix will also provide support to participating laser systems in Hawaii and Texas and to the Transportable Laser Ranging System No. 1.

Under the terms of the contract Bendix will manage the GLTN to provide specified tracking data in a timely and cost-effective manner through the generation of orbit prediction, scheduling of GLTN activities, data management, and preprocessing and data quality assessment.

The GLTN is currently part of the Goddard Spaceflight Tracking and Data Network. Under the new contract the laser network will become a separate entity.

The Persuader. . .con't from 1

The warning on page one is not for an amusement park ride. It is for the Seat Belt Persuader demonstrated at Goddard recently. As the picture shows, a person can really get jolted around (even while wearing seatbelts) inside a car when it has to stop abruptly. Put your seatbelts on. They are there for a purpose.



Before your children go out trick-or-treating, set up boundaries and a time for them to be home (if the children are very young, you should go with them). Children should only go into neighborhoods where they are known.

Here are some further recommendations from the National Safety Council:

- Do not block a child's vision with a mask. Use make-up instead. Make sure at least part of the costume is light in color; if not, attach bright reflecting tape to the child's bag or costume.
- Do not allow children to carry candles or sharp instruments. Do have them carry a flashlight.
- Tell children not to go inside a house if invited. They should walk only on sidewalks, not in the street.
- Tell children not to eat any candy until they are home. Check carefully to make sure candy has not been tampered with. If you are unsure, don't take a chance—throw the candy away.

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