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GODDARD NEWS

Delta Launches HEOS-2 Into Orbit

Delta 87 successfully launched the European Space Research Organization's (ESRO) Highly Eccentric Orbit Satellite (HEOS-2) into polar orbit January 31. The three-stage Delta-L placed the scientific satellite into an elliptical orbit of 439 kilometers (272 statute miles) by 248,160 kilometers (153,859 statute miles). The launch took place at 12:20 p.m., EST, from the Western Test Range at Lompoc, California.

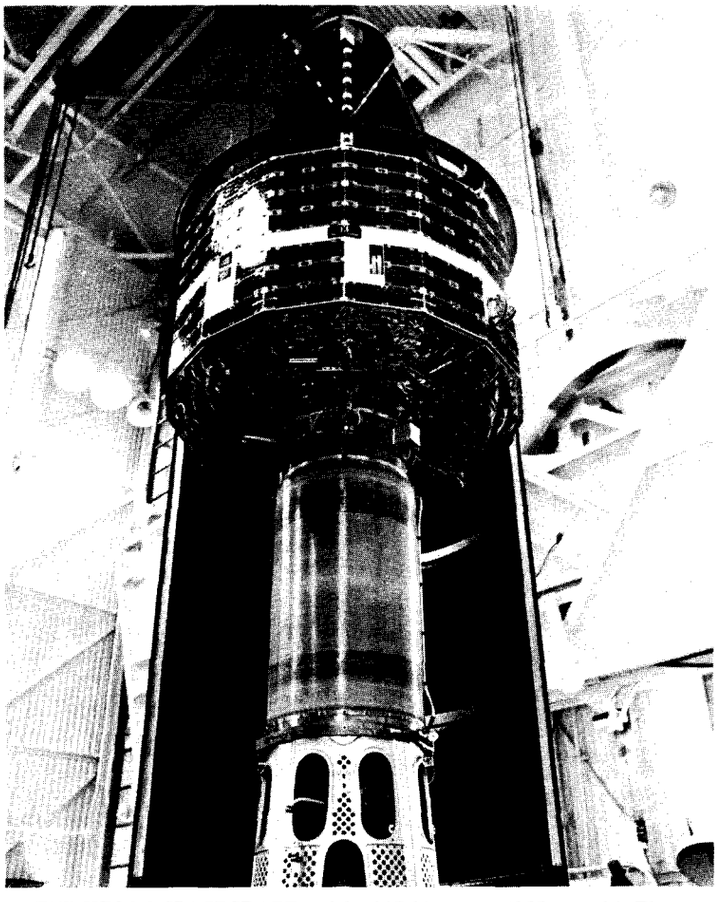
Seven experiments are aboard HEOS-2 to investigate the strength and direction of magnetic fields encountered, the energy distribution of protons and electrons, the nature of the solar winds, make very low frequency solar observations and detect micrometeorites. In particular, HEOS-2 will investigate the northern neutral point of the magnetosphere to determine if it is an entry point for particles from interplanetary space.

Performance of the Delta rocket was near nominal, according to Delta Project Manager William Schindler. He has been informed by HEOS Project Manager Maurice Delahais that ESRO is pleased with the orbit and that all seven experiments aboard the spacecraft are operational.

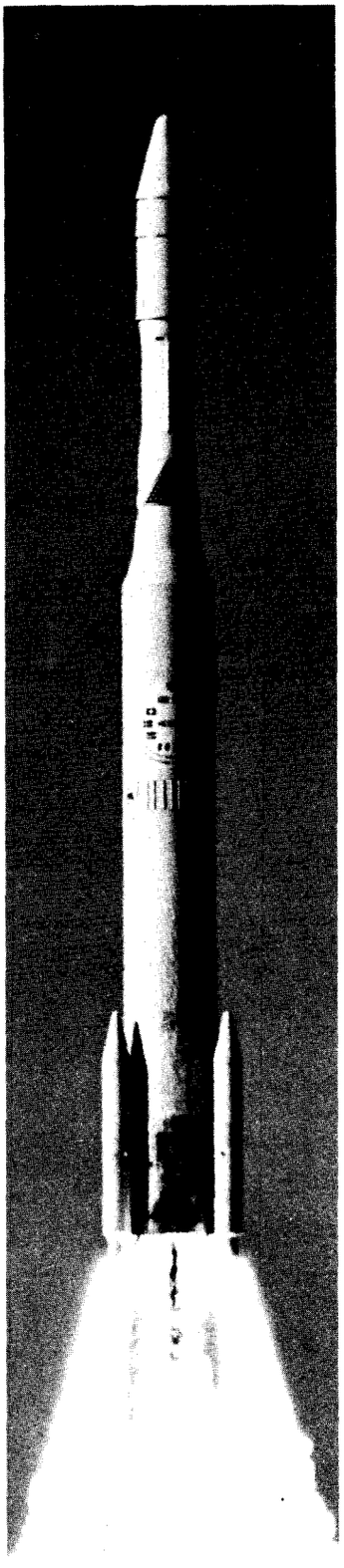
Following launch and tracking support during the first orbit control of the spacecraft was taken over by the European Space Operations Centre at Darmstadt, West Germany.

Other key GSFC personnel involved in the HEOS-2 launch were Robert Goss, Goddard HEOS-2 Project Manager; Charles Gunn, Delta Technical Officer; Robert G. Sanford, Mission Operations System Manager and Mission Support Manager; Gerald A. Davis, Network Support Manager; Richard A. Schumacher, Control Center Operations Manager; and Mrs. Ellen L. Herring, Orbital Computations Engineer.

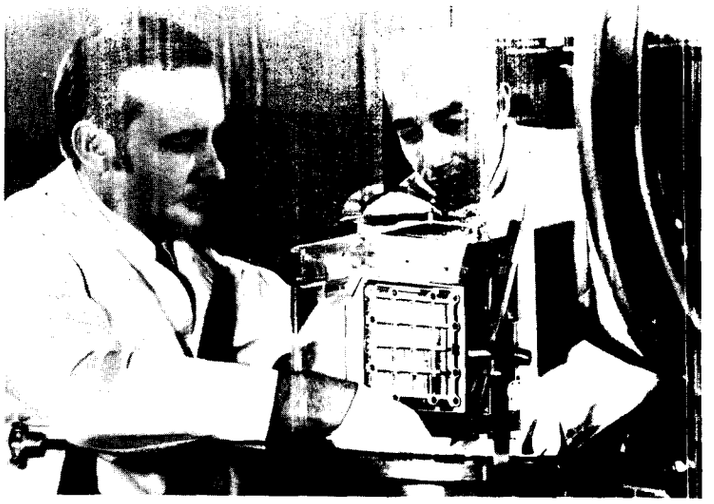
ROBERT GOSS, Goddard's HEOS-2 Project Manager (right) discusses successful launch with Maurice Delahais, HEOS Project Manager, William Schindler, Delta Project Manager and Erich Eitlhuber, HEOS Project Manager for M.B.B., the satellite contractor.



THE HEOS-2 SPACECRAFT weighs 117 kilograms (257 pounds). The 16-sided cylinder has over 70 percent of its exterior surface covered by solar cells. The spin-stabilized satellite carries seven experiments. The European Space Research Organization is comprised of ten nations.



DELTA 87 LIFTS OFF in a bright California sun carrying the HEOS-2 scientific satellite. The spacecraft was placed into a highly elliptical polar orbit. Life off occurred at 12:20 p.m., EST, January 31, from the Western Test Range at Lompoc, California.



GODDARD'S FRANK RICHARDSON (left) and Bob Taylor, Quality Assurance and Test Department of Bendix Aerospace Systems Division, remove the LEAM experiment from calibration chamber. Although several Goddard experiments have been flown on Apollo missions, LEAM is Goddard's first surface experiment.

Goddard's First Lunar Surface Experiment

Goddard's first lunar surface experiment, the LEAM (Lunar Ejecta and Meteorite) experiment is scheduled to be placed on the moon by the crew of Apollo 17, late this year, according to Principal Investigator Otto E. Berg of the Laboratory for Space Physics.

The small, box-like device, mounted on four legs, is 31 centimeters high (12 inches) by 25 centimeters deep (11.5 inches) by 40 centimeters long (15.3 inches). It weighs 7.2 kilograms (15.75 pounds). Astronauts will place the package about 7.6 meters (25 feet) from the Apollo 17 ALSEP package.

LEAM is designed to operate for more than two years on the moon, measuring impacts on its sensors by tiny lunar and cosmic dust particles. It is patterned after a similar experiment Mr. Berg provided for earlier NASA interplanetary Pioneer spacecraft.

The moon is an ideal place for an experiment of this type, according to Mr. Berg, because it serves as a giant impact area. With detectors mounted on three sides of the device, measurements will be made of the trajectories, velocities, weight and other characteristics of tiny dust particles impacting on the moon.

These particles, or micrometeorites, are too small to be seen with the naked eye. They have been found in practically all regions of space explored to date. Their origin is primarily from comet debris.

LEAM was built for Goddard by the Time-Zero Corp, Torrance, Calif. It is being integrated by Bendix Aerospace Systems Division, Ann Arbor, Michigan. It underwent calibration checks last month in Mr. Berg's laboratory located in Building 4.

LEAM PRINCIPAL INVESTIGATOR, Astrophysicist Otto E. Berg, checks flight model of the experiment Apollo 17 astronauts will place on the moon to measure dust particle impacts.

TEAM EFFORT overcomes Explorer 45 coning problem. Relaxing after successfully solving the problem are some of the people who sent almost 3,000 attitude commands over a period of several weeks to Explorer 45 to reduce its severe post-launch wobble. Seated (from left) are Bill Crawford, RCA; Sterling R. Smith, Project Operations Director; and Tom Flatley. Standing are Charlie Grames, RCA; A. E. Sersen, RCA; M.D. Sweetin, RCA; Clark Wardrip, Goddard; Henry C. Hoffman, Head, Stabilization and Control Branch; Jim Stephens, Goddard; John Pyle, Goddard; and Roger D. Werking, Goddard. Not shown are Jack Nieberding, R. Clagett, Ed Hildebrand, all of Westinghouse, Bob Wettingfeld, Goddard, and John Beaird of RCA.

Explorer 45 Wobble Wanes

Soon after the successful launching of Goddard's Explorer 45, last November, from the San Marco Platform, a build-up of the coning motion of its spin axis occurred unexpectedly.

The "wobble" increased alarmingly and by orbit 20 it reached 24 degrees full angle. Success of the mission became questionable unless the unstable condition could be overcome.

Satellite stabilization and dynamics experts at Goddard were called in to find a solution before it was too late.

The problem was complicated by the fact that the "patient" was in an elliptical orbit ranging from 230 to 26,800 kilometers above the earth.

A three-point plan was quickly developed which, over the next few weeks, was to involve almost 3,000 attitude control commands to the satellite. First, the satellite angle relative to the sun was changed because the experts believed that the long electric field experiment booms were being shadowed periodically due to coning. Second, a complex series of commands, issued during perigee passes, were sent to the attitude and spin control system (ASCS) to inhibit coning. Third, a long-term increase in the spin rate from four rpm to seven rpm was accomplished by other commands to the ASCS.

Gradually, the plan succeeded. The coning decreased significantly. By orbit 30 it was down to 18 degrees; by orbit 40 to 10 degrees, and eventually it stabilized at 1.6 degrees.

Frank Carr, Explorer 45 Assistant Project Manager, who headed the overall effort, said this is "an acceptable amount to permit experiment operation in the preferred mode for data collection."

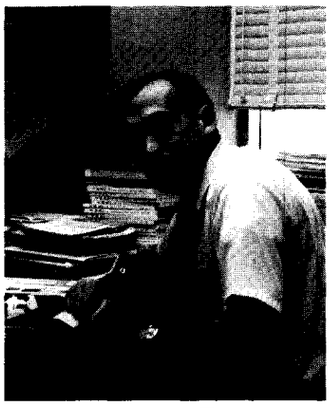
He attributes success of the effort to people in MSOCC, the Attitude Determination Office as well as the Data Techniques Branch, the Electronic Integration Branch, and the Stabilization and Control Branch, the latter of the Space Applications and Technology Directorate.

Group leaders who led the effort were Dr. Thomas Flatley (Explorer 45 Dynamist), Roger Werking (Attitude Determination Office), and John Pyle (Optical Aspect and Data Sync Clock Design Engineer).

The spacecraft itself was also called upon to perform "above and beyond the call." The ASCS responded to thousands of commands. Also, more than twenty complete reprogrammings of the on-board data system memory were performed in order to sample the proper data needed to determine the timing and phasing of the attitude commands, and then to restore the data system to the normal data collection made for the remainder of the orbit.

The latest information on the performance of Explorer 45 is that all experiments and subsystems are working perfectly and significant scientific results are expected. Project Manager Gerald W. Longanecker's five-year ordeal has apparently come to a happy ending.

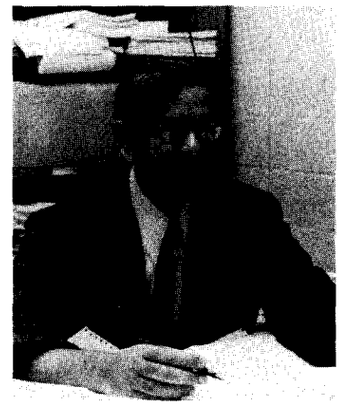
Goddard Employees from Other Lands



A Laboratory Chief, a Station Director, and a scientist who studies the chemical composition of Moon rocks—these are three of the foreign employees working here on Center and at the Goddard Institute for Space Studies in New York City.

At present, Goddard has 19 people from eleven countries. They come from Argentina, Austria, Australia, Canada, China, England, India, Iran, Israel, Italy, and Japan. While most are scientists, some are employed in administrative or engineering positions.

On this and the following page are pictures and capsule biographies of most of them.



MARIO H. ACUÑA of the Space Plasma Physics Branch comes from Cordoba, Argentina. Since joining the Goddard staff in 1969, he has worked on a variety of instrumentation including miniature magnetometers, pulse code modulation telemetry systems, and ranging and attitude systems. He holds a patent for a "Two-Axis Magnetometer." He graduated with a MSEE from the University of Tucuman in Argentina, and has attended Davidson College in North Carolina. He is now enrolled in Catholic University in Washington, D.C. where he is presently a Ph.D. candidate. From 1963-1966 he worked at Goddard for the Argentine government in the International Ionospheric Research Program.

DR. V. K. BALASUBRAHMANYAN, of the Laboratory for High Energy Astrophysics, came to Goddard in 1965 from India. He is a graduate of Calcutta and Madras Universities, and received his Ph.D. from Bombay University in 1961. At Goddard his work involves the study of high energy cosmic rays and their relationship to astrophysical phenomena. He is a co-investigator for the High Energy Cosmic Ray Experiment for the High Energy Astronomical Observatory (HEAO), and has taken part in the IMP 1, 2, and 3, and OGO 1 and 5 projects, and several balloon Flights of the Cosmic Ray Group.

Dr. Brian R. Dennis

Dr. Upendra D. Desai

DR. ANAND K. BHATIA of India first came to Goddard in 1963 on a National Academy of Science Fellowship and then joined the Center staff in 1965. A member of the Theoretical Studies Branch, he conducts a wide range of research in such fields as the scattering of electrons and positrons from atoms and the resonances of atoms and ions. He received his B.S. degree from St. Stephen College of Delhi University in 1953 and his Ph.D. from the University of Maryland in 1962. Before coming to Goddard, he was Assistant Professor of Physics at Wesleyan University in Middle Town, Connecticut.

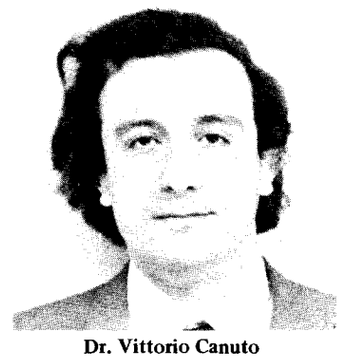
DR. VITTORIO CANUTO joined the Goddard Institute for Space Studies in New York in 1968. Born in Turin, Italy, he attended both Valsalice College and the University of Turin there, and received his Ph.D. from the University of Genova in 1960. Before coming to NASA, he was a full professor at the University of Mexico. At GISS his work concerns high energy astrophysics with emphasis, at the present time, on the study of super-dense matter in collapsed bodies or neutron stars. He also supervises the Ph.D. theses of students in his group and is chairman of the GISS colloquium series.

DR. SUSHIL CHANDRA of the Laboratory for Planetary Atmospheres is responsible for the study of theoretical problems of interactions of solar ultraviolet radiation with planetary atmospheres. He was Principal Investigator for the OGO 4 RPA experiment. Dr. Chandra, a citizen of India, came here in 1965 after a year as Senior Science Officer at the National Physical Laboratory in New Delhi, India. Before this he was a NAS/NASA Research Associate. In 1961 he received his Ph.D. in Physics from Pennsylvania State University.

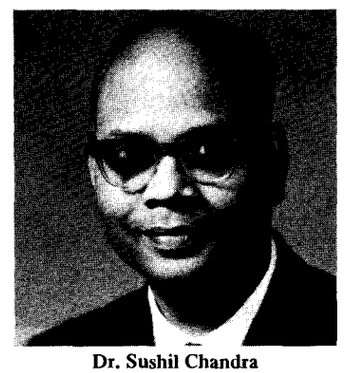
DR. BRIAN R. DENNIS of England came to Goddard in 1967. As a member of the Solar Plasmas Branch, he has taken part in numerous balloon-flight experiments using X-ray detectors. He is Co-investigator on the X-ray detector to be flown on OSO-I and on data analysis of results from the detector on OSO 5. Before coming here, he was a Research Associate at the Department of Physics and Astronomy at the University of Rochester, New York. He was born in Lincolnshire, England, and received his Ph.D. in Physics from Leeds University.

DR. UPENDRA D. DESAI is a member of the Laboratory for High Energy Astrophysics. Presently he is working on the design and development of the UK 5 X-ray experiment and the design and development of a telescope for X-ray astronomy. His past projects have included the Explorer 12 and 14 particle experiments and the study of radiation damage in MOS devices. He was born in Amod, India, and received his Ph.D. from Gujarat University in Ahmedabad.

Dr. Anand K. Bhatia



Dr. Vittorio Canuto



Dr. Sushil Chandra

(See Page 4)

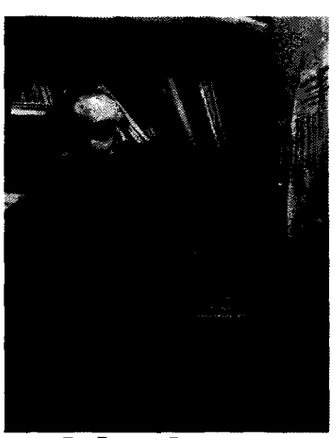
EMPLOYEES. . . .From Page 3

John E. Dowling

JOHN E. DOWLING, Station Director of the Merritt Island tracking station near Cape Kennedy, was born in Keswick, South Australia. His varied career includes six years with the Royal Australian Air Force, a B.E.E. degree from the University of Western Australia, and 11 years with the Australia Department of Supply. During the IGY he was the Principal Officer in Charge of the Minitrack station in Woomera. He came to the U.S. in 1960 as the Australian Government Representative to the United States for Project Mercury and joined NASA in 1962. He has been Station Director at Merritt Island since its establishment in 1965.

Dr. Han-Shou Liu

DR. HAN-SHOU LIU, a scientist assigned to the Geodynamics Branch, came to Goddard in 1963. Before joining NASA, he was a Research Associate for the National Academy of Science. He was born in Hunan, China, and received his Ph.D. from Cornell University in Ithaca, New York in 1963. During both Apollo 14 and Apollo 15, he provided technical commentary on the missions for Voice of America broadcasts in Chinese.


Dr. Reuven Ramaty

DR. KAZEM OMIDVAR, of Mashad, Iran, came here in 1960. As a research physicist in the Theoretical Studies Branch, he does research in fundamental and applied physics with emphasis on atomic structure, problems in atomic and electronic collisions, and astrophysics. He has published close to 20 articles in scientific journals. He received his B.S. from Teheran University in Iran, and his M.S. in 1953 and his Ph.D. in 1958 from New York University in New York City. During 1969-1970, while on leave from Goddard, he was visiting professor of theoretical physics at Teheran University.

Dr. Anne B. Underhill

DR. JOHN A. PHILPOTTS of England is well known on Center for his work with lunar samples. A member of the Planetology Branch since 1965, he conducts geochemical analysis of returned lunar samples from both the Apollo missions and Luna 16, and also of terrestrial samples and meteorites. He is a member of the Lunar Sample Review Board of the Lunar Science Institute. Before coming here, he held a number of posts including teaching in the summer school of the National Science Foundation and conducting a geological survey of Canada. He earned his B.S and M.S degrees from McGill University in Montreal, and his Ph.D. from MIT in Cambridge, Massachusetts.

DR. CUDDAPAH PRABHAKARA of India graduated with a M.S. degree from Andhra University in 1957 and received his Ph.D. from New York University in New York City in 1964. In 1966, he came to Goddard. As a member of the Meteorology Branch of the Laboratory for Meteorology and Earth Sciences, he works on the remote sensing of the Earth's atmosphere and surface properties, and on studies of radiation transfer, atmospheric ozone, and planetary circulation.

DR. REUVEN RAMATY was born in Timisoara, Romania, but is now a citizen of Israel. He received his BS from the University of Tel-Aviv in Israel in 1962, and his Ph.D. from the University of California in Los Angeles in 1966. After a year as Assistant Research Geophysicist at UCLA, he came to Goddard as a NAS/NASA Research Associate in 1967 and officially joined the Center staff in 1969. As a member of the Laboratory for High Energy Astrophysics, he conducts research in theoretical high energy astrophysics. He also organizes the joint seminar with the Space Physics Group at the University of Maryland, and advises Maryland Ph.D. candidates on their thesis projects.

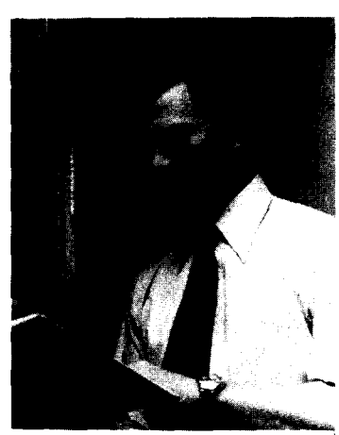
DR. DAVID E. SMITH, Head of the Geodynamics Branch, was born in London, England. As Branch Head, he plans a program of research which includes research into the determination of the pole of rotation of the Earth from the observation of satellites. Before coming to Goddard in 1969, he spent nearly ten years in the Civil Service in England at the Radio and Space Research Station. From 1969 to 1971, he was a consultant in satellite geodesy to the Mission Trajectory and Analysis Division here. He received his BS from the University of Durham in 1958, and his MS and Ph.D from the University of London in 1962.

DR. ANNE B. UNDERHILL of Canada became Chief of the Laboratory for Optical Astronomy in September of 1970. She is responsible for organizing and directing a comprehensive program of research in astrophysics and astronomy. Born in Vancouver, British Columbia, she received her B.A. in 1942 and her M.A. in 1944 from the University of British Columbia. In 1948 she received her Ph.D. in astrophysics from the University of Chicago. From 1949 to 1962, she was an astrophysicist and later Senior Scientific Officer at the Dominion Astrophysical Observatory in British Columbia. She was then Professor of Astrophysics at the State University of Utrecht, the Netherlands for eight years before assuming her present post.

Dr. Kazem Omidvar

Dr. John A. Philpotts

Dr. Cuddapah Prabhakara


Dr. David E. Smith

AMBASSADOR CARLOS MANTILLA of Ecuador and members of his staff were at Goddard on January 7, 1972 for a meeting with Deputy Director Donald P. Hearth and a tour of the Test and Evaluation Division and the Network and NASCOM control areas. Shown here are (from left) Navy Captain Gotardo Valdiviezo, Teodoro Jaramillo of Goddard's Data Systems Section, Army General Raul Samaniego, Ambassador Mantilla, Mr. Hearth, Air Force General Jorge Izurieta, and Minister Counselor Orlando Gabela.

RUTH BATES HARRIS, NASA Director of Equal Employment Opportunity, was at Goddard on February 4. Shown here during the visit are (from left) Dr. John F. Clark, Goddard Director; Mrs. Harris, Robert King, Director of the Equal Employment Opportunity Office at Headquarters; Mrs. Lillian Cunningham of the NASA Equal Employment Opportunity Staff; and Dr. Michael J. Vaccaro, Goddard Director of Administration and Management.

ARIEL 4 FULLY OPERATIONAL. Donald Miller (right), Ariel 4 Mechanical Systems Engineer looks on as Ronald Adkins, Ariel 4 Experiment Coordinator, points out University of Iowa experiment location on model of the British-built satellite. The Iowa experiment was turned on in mid-January making the five-experiment, ionosphere-study satellite fully operational. It was launched from the Western Test Range December 11, last year. Goddard Ariel 4 Project Manager is Herbert L. Eaker.

NASA's EEO Director Here

Mrs. Ruth Bates Harris, NASA's new Director of Equal Employment Opportunity, made her first official visit to Goddard on Friday, February 4, 1972. During her visit Mrs. Harris met with Dr. John F. Clark, Goddard Director, Donald Hearth, Deputy Director; Dr. Michael J. Vaccaro, Director of Administration and Management; the Center's Equal Employment Opportunity Staff, and several groups of employees.

Mrs. Harris has had a distinguished career in the field of human relations. Prior to joinint NASA she was the Director of the Human Relations Department, Montgomery County Public Schools. She formerly was Executive Director of the D.C. Commission of Human Relations. Mrs. Harris is an honor graduate from Florida A&M University where she received her BA in Science and Administration. She is also a honor graduate from New York University where she received the MBA degree.

Goddard Environmental Study Group

The Goddard Environmental Study Group was formed a year ago and has been operating with the objective of promoting greater understanding of ecological-environmental issues through a series of sponsored talks. These are open to all Goddard employees and are held during the lunch hour to minimize conflict with employee's normal work activities.

ORGANIZERS of Goddard's Environmental Study Group are (from left) Dr. Robert Mueller, Dr. Stuart Jordan, Ruth Marsh and Fred Gordon.

Talks to date have included discussions of solar energy and power, strip mining legislation, coal mining – a company's position (a conservationist will speak on this topic in the near future), national timber cutting policy, the ERTS program's environmental impact, and population dynamics among mice with possible implications for human population dynamics. Further talks on nuclear power plants, the ecology of small lakes and ponds, and other topics are being planned. A deliberate effort is being made to present both sides of controversial issues. Special discussion meetings are sometimes held to treat specific topics, and all sponsored talks are followed by lengthy informal discussions with the invited speakers.

In addition to these talks, the group is sponsoring a bicycle trail connecting Goddard with adjacent communities. Approval has been obtained from Greenbelt for such a trail, a presentation will be offered the Goddard Facilities Planning Committee regarding the same, and informal correspondence with the National Park Service has elicited a strong interest on their part to study the proposal with an eye to funding the necessary construction.

The group consists of some 50 members at present. A smaller number of people have been particularly active in organizing programs. There is no official slate of officers at this time, as the idea was to concentrate on a few activities first and let the organizational structure evolve in an "organic" manner, to use a contemporary term. Fred Gordon has played a strong role in organizing talks. Stuart Jordan was one of the prime movers and, along with Bob Mueller, has contributed several ideas. The activities of Ruth Marsh in contacting members and coordinating many of the functions have been extremely valuable and are greatly appreciated by all members. A number of other people have offered good ideas and have helped in many ways. For further information, contact either Stuart Jordan at x-4874 or Ruth Marsh at x-2680.

PROCESSING SUBMITTED PROGRAMS. Martha Anne King and Rodell Tucker write abstracts for inclusion in the computer program library catalog.

PAT BARNES delivers to William Davenport his requested program tape and documentation.

MARGARET APPELL (left), Larry Galola and Marie Dudley process requests for programming manuals as one of the services of the Computer Program Library.

Goddard's Computer Program Library Saves Time and Cuts Costs

The chief goals of Goddard's Computer Program Library are to make work easier for the Center's programmers, and to reduce costs by eliminating duplicated effort. In 1971 alone, users reported estimated savings of $217,000 and 300 man-hours.

The library (CPL), located in Room 133 of Building 3, collects all computer programs and associated documentation related to Goddard projects and, upon request, to distribute these materials to qualified users. To this end, the library maintains over 1000 active program files.

First established in 1962, the library is now run for Goddard by Chesley H. Looney's Computation Division under the direction of Charles W. Mentges, Head of the Computer Services Section. Chief contact for library users is Mrs. Pat Barnes who has been CPL Librarian for the past ten years. Mrs. Barnes is assisted in CPL operations by Computing and Software Inc., personnel, who are supervised by Michael L. Burgess.

A Computer Program Library Committee was established in 1970 for the purpose of reviewing the contents of the library by evaluating each program file. The Committee also recommends improved library procedures and services. Questions or suggestions regarding the activities of this committee should be directed to the Committee Chairman, Darrin H. Gridley, Code 540.

Overall operation of the Goddard Computer Program Library includes registering, receiving and retrieving. The library registers new programming efforts as they are begun, and receives for its files the programs and documentation when completed by the programmer. Registration is required for all significant programs run on general purpose (Category A) equipment. Programming efforts may be registered with the CPL by calling Ext. 2186.

Perhaps the most important function of the CPL is retrieval of programs from Goddard sources as well as from off-site sources. Goddard programs are described in the *Catalog of the GSFC Computer Program Library* which contains indexes and abstracts of items in the library. A complete catalog is published annually. An addendum is published six months later and distributed to all recipients of the main catalog. To be placed on the catalog distribution list, call Ext. 2186 or 4672.

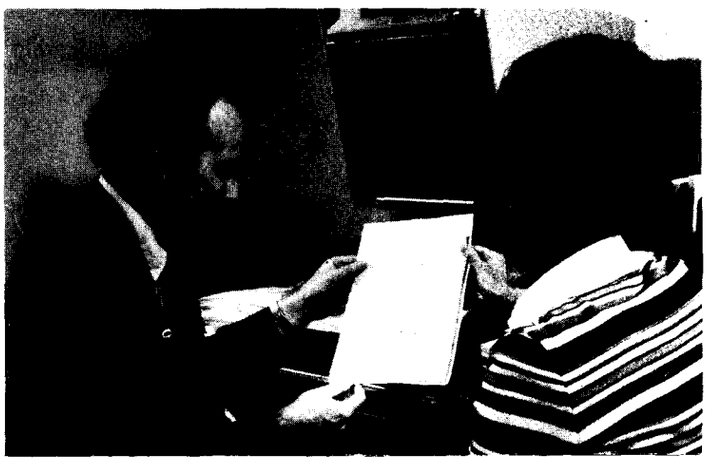
The library also has access to off-site sources, including the NASA ADP Resource Sharing System, the Computer Software and Management Information Center (COSMIC), SHARE (IBM user's group operated by COSMIC), and the Univac Science Exchange (USE). These libraries provide program materials to Goddard upon request.

When a request is received at the Library, the CPL staff will provide copies of the available items, including tapes or card decks, listings and related documentation.

Since material in the CPL, may be applicable to many areas of effort, Goddard personnel are reminded that Goddard Management Instruction (GMI) 2410.4 specifies that programming sponsors "are responsible for initiating program development so that maximum use is made of programs already in the GSFC Computer Library, and so that significant programs are adequately documented and deposited in the library".

To aid in compliance with this GMI, the CPL personnel will help search available catalogs for applicable programs. Specific programs may be requested, or a general library search for materials may be initiated, by calling Mrs. Barnes on Ext. 6796.

RUTH LINSTROM assists Leslie Salter in retrieval of program information using the Library's microfiche reader-printer.



SCANNING one of the Library's references, William Davenport and Dr. David Fischel search for an appropriate program.

SCIENCE AND ENGINEERING REPORTS

HARVEY WALDEN, a physicist in the Trajectory and Dynamics Branch, has been at Goddard since 1963 and is a technical consultant on dynamics problems to the RAE Project. He earned his degree in physics at Rensselaer Polytechnic Institute in New York and has continued graduate study at the University of Maryland through the Goddard Three-Quarter Graduate Program. He served as Co-experimenter for the RAE dynamics experiments.

Gravity-Gradient Dynamics Experiments

By Harvey Walden

The method of passive gravity-gradient control of orbiting spacecraft makes use of an extremely simple principle of physics, yet has proved to be surprisingly elusive to attain in actual practice. Gravity-gradient stabilization, in its full three-axis form, is a technique for controlling a satellite's attitude, or pointing direction, by use of the gravitational field of the Earth but without the aid of active control devices such as gas thrusters. The laws of physics dictate that a long slender spacecraft configuration in orbit will tend to align its greatest dimension with a line joining the spacecraft center of mass and the center of the Earth.

After several unsuccessful attempts at three axis gravity-gradient stabilization, the first Radio Astronomy Explorer (RAE-1) satellite, launched from the Western Test Range in California on the 4th of July in 1968, demonstrated conclusively and dramatically the feasibility of using gravity forces to maintain passive attitude control. Since one of the primary scientific missions of the RAE-1 satellite is to map the celestial sphere at radio frequencies, a stable capture by gravity-gradient forces was essential to permit modest pointing accuracies by the long directive Vee-antenna booms. The RAE primary antenna booms measure almost a half kilometer (1500 feet) from tip to tip. These extreme lengths and the fact that the booms are formed of a hollow tube only about one centimeter (a half inch) in diameter introduced complexities of stability and dynamics not encountered previously in other satellite missions. However, thorough design analysis anticipated and overcame the problem of large boom distortions due to solar heating that was generally blamed for the unstable behavior that had plagued previous gravity-stabilized spacecraft.

During the first two years that elapsed following the deployment of the RAE-I antenna booms to full lengths in October 1968, angular motions about the three-axis equilibrium position were generally confined to three or four degrees, as predicted prior to launch on the basis of computer simulations of the RAE dynamics. The original concept of utilizing the RAE-I spacecraft to perform dynamics experiments was propounded by the RAE Dynamicist, David L. Blanchard, in October 1969. By perturbing the satellite's steady-state behavior in orbit, it was felt that information would be obtained that would aid in understanding in greater detail the method of gravity-gradient control. This information would be of particular value in planning for the second radio astronomy mission (RAE-B), scheduled for orbit about the moon, rather than the Earth, in 1973 with an identical system of gravity-gradient attitude stabilization.

In July 1970, the concept was formalized and an unusual sequence of six gravity-gradient dynamics experiments was proposed to NASA Headquarters jointly by Dr. Blanchard and this author. These experiments were unusual in at least two highly significant respects: (1) they would treat the RAE-I spacecraft itself as an experimental apparatus, and (2) the experiment proposal was initiated long after the spacecraft had been launched and had achieved a successful mission. NASA Headquarters, after receiving assurances from the RAE Program Manager, Frank W. Gaetano, the RAE Project Manager, John T. Shea, and the RAE Project Scientist, Dr. Robert G. Stone, that the experiment concept had their backing, granted approval to proceed with the program of dynamics experiments in November 1970. The in-orbit experiments were begun in early December 1970, and performance of the full set of six continued over the course of the following thirteen months, ending just prior to the beginning of 1972.

Two experiments involved clamping, or de-activating, the on-board libration damper mechanism, once when the orbits were in full sunlight and once when each orbit was in partial solar shadow. Two other experiments involved partially retracting one of the pair of lower antenna booms with the damper active and later re-extending it to full length with the damper "off." The final two experiments, the most ambitious of the series, involved partial retraction of both lower antenna booms simultaneously with the damper clamped and later full re-deployment with the damper in an active status. These experiments were designed to uncover such information as the capabilities and effectiveness of the on-board damper system, the dynamical behavior of the satellite under adverse conditions (for instance, mismatched boom lengths and an inactive damper), and the in-orbit values for certain spacecraft mechanical parameters which were previously estimated on the basis of pre-launch measurements.

The performance of the dynamics experiments was wholly successful, without adverse impact to either the spacecraft structure or to its scientific mission. The desired angular disturbances to the steady-state spacecraft attitude condition were generated as planned with the assistance of pre-experiment computer simulations of the in-orbit dynamics. Large angular motions occurred as predicted following the boom retraction and re-deployment operations, and these perturbations to the spacecraft dynamical behavior were monitored closely in a near real-time mode at the satellite control center. In addition, large amounts of dynamical data were gathered on the time history of the attitude motions, the movements of the damper boom when actively removing energy from the spacecraft system, and the bending responses of the flexible main antenna booms. Once the operational performance of the dynamics experiments was completed in December 1971, the RAE-I satellite returned to its radio astronomy investigations.

In the relatively short time that has passed since the performance of the first dynamics experiments, much new information has already been gleaned from analysis of the data. The successful conduct of the experiments demonstrated the capability of the RAE spacecraft to survive and recover from adverse dynamical situations, such as might be encountered in any of certain possible failure modes for the upcoming RAE-B lunar mission. In addition, the on-board mechanical and electrical systems have been shown to perform satisfactorily and reliably after more than three years in the hostile environment of space. The pre-experiment computer simulations that were undertaken and that proved remarkably accurate in predicting in-orbit dynamical behavior generated increased confidence in the validity and adequacy of these programs and the analytical techniques employed in the RAE studies. Specific new results pertaining to the on-board damper system include the fact that significant capability for reducing large attitude motions is present, but only marginal success in alternating dynamical disturbances near equilibrium conditions was experienced. This is the first in-orbit verification of this feature of the damper design that was predicted on theoretical grounds before launch. One surprising result relating to the damper was the observation that it appears to be more effective for an asymmetric spacecraft configuration, such as mismatched boom lengths, than otherwise. Finally, the successful performance of these experiments has promoted increased assurance in the achievement of a successful RAE-B lunar mission next year.

Goddard Mourns. . .

Harry D. Helfrich, Head of T&E's Flight Program Office, died suddenly of a heart attack on January 6, 1972. He was responsible for providing staff support to Goddard spacecraft projects for test activities and the coordination of various test programs in the Test and Evaluation Division.

Before coming to Goddard in 1965, he served in the U.S. Navy until retiring as a Captain in 1962, and then worked at the Martin Marietta Corporation.

Funeral services were held at the Fort Myer Chapel with interment in Arlington National Cemetery. Mr. Helfrich is survived by his wife Diana Hope Helfrich, children and grandchildren.

Presidential Recognition Program

The Goddard Space Flight Center has the opportunity each month to nominate five individuals and organizations for special recognition by the President of the United States. This program, which has been underway for some two years, provides a basis for Presidential recognition of specific, voluntary contributions to the improvement of life in the United States.

The following represent some of the areas that deserve consideration: Heroic acts – rescue from drowning, fires, auto wrecks, etc.; culture – contributions in music, theater, or art; social welfare – youth work, assistance to minority groups, services for the helpless and aged, etc.; environmental – beautification programs, anti-pollution work, etc.; public health programs, educational programs; technological achievements or inventions that aid crippled persons or the aged to lead fuller and happier lives.

Personal knowledge of the nominee's contribution is desirable; however, news articles or other sources subject to verification are acceptable. Justification should include the name and home address of the nominee, together with a synopsis of the specific contribution made by the individual or organization. Nominations of individuals outside of the federal government are especially welcome, as well as individuals and organizations not in the immediate Goddard area.

Persons or organizations nominated for Presidential commendation should not be notified that they are being considered for such recognition because not all nominees are ultimately selected for this high honor.

All Goddard employees are encouraged to submit nominations for Presidential recognition. A special form is available in the Awards Office to aid you in submitting nominations. For information or assistance, you may call Nancy Libby, extension 6004.

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Goddard's 'Harry Homeowners'

If you think your home repair job-jar is always filled, how would you like to be "Harry Homeowner" for a place housing over 7,000 people? Chances are you wouldn't. But to Tony DiBartolo and his group of 22 professional pipefitters, welders, machinists, sheet metal specialists and air conditioning experts, it's a challenging career.

Imagine keeping up with a steam system which heats and air conditions a home as large as a 50-story office building? For Tony and his crew in "Shop 21" it means checking and packing over 1,000 system valves a year, checking and cleaning every air conditioning unit on the Center at least four times a year, and doing an unimaginable number of maintenance jobs on refrigeration motors, pumps and compressors.

The Plumbing, Heating and Ventilating Shop, known as "Shop 21," is an integral part of the Center's Plant Operations and Maintenance Division. The shop is part of Mr. Jay R. Jett's Maintenance Branch. Tony's two lead men are Frank Cole and Tom Mooney.

The motto of the "Shop 21" group is "Keep 'Em Running." Even if you don't see Tony or any of his people around, you know they are there because, somehow, everything keeps running. Often, work is done after everyone else has gone for the day.

Ask any of Tony's people what they do and the answers will be varied. In addition to installing water-using equipment such as hot water heaters, vacuum pumps and sinks, the "Shop 21" people maintain the Centers's domestic water and sewage systems. Welders repair high and low vacuum systems on a routine maintenance basis and in emergency situations.

Need a mechanical door, vacuum pump, or crane repaired? Want some help with a ground support trailer going overseas? Need a custom sheet metal shroud for one purpose or another? Or maybe you need a filter changed? If so, submit your work request to Code 290.

The "Shop 21" people work closely with the Center's carpenters and electricians, engineers, and control men, to mention only a few of the coordination requirements.

TONY DiBARTOLO, Plumbing, Heating and Ventilating Shop Foreman; and Frank Cole, Pipefitter Leader; consult with John Klish and Henry Obler, mechanical engineers from the Facilities Engineering Division, about the cause of failure and the repair of an air compressor.

Goddard Automobile Club

A group of Goddard employees, headed up by Tom Davis, have banded together to fight the over-charging for simple maintenance work on their cars. The aims of the group, which was formed last December, are to teach basic auto repair as well as to arrange parts discounts and acquire a workshop where simple maintenance may be performed.

So far, the Goddard Automobile Club program has included two films, one on tire hydroplaning and another on defensive driving. More films, speakers, and discussions will be presented in the future. On the practical side, the club has arranged discount rates on parts and oil with some nearby distributors, and as membership grows, hopes to develop more.

Future plans of the Club include course instruction, acquisition of a workshop, and a possible rally group. Since the majority of present members, particularly women, are interested in taking a course in auto repair from the ground up, a class is definitely planned for this spring. Yet, all these plans depend on a large and active membership. New members are not only wanted, they are badly needed.

The club is approved by GEWA, and present members are anxious to get things going. There are many avenues open for the future, and the club would be most happy to hear any and all suggestions you may have. Anyone interested in joining or obtaining more information should call Walt Glazar on Ext. 4178.

GODDARD AUTOMOBILE CLUB. Walt Glazar instructs Pat Pierce in the use of a timing light.

NASA 1972 European Trip

People from all the NASA centers have expressed interest in the upcoming European trip planned by the NASA Employees Club. The trip leaves from Dulles Airport, Washington, D.C., for London on May 28, 1972, returning from Paris on June 18. The flight alone, a "Grand Tour," or an "Iberian Tour" may be taken. For those interested, deposits should be made as soon as possible, preferably before March. Final payments have to be made by March 20, 1972. For further information, contact Bernard Maggin, NASA Headquarters, Code RG.

Ski Club Finds Winter Fun

There was plenty of snow and fine skiing conditions in Killington, Vermont, for the first trip by members of the Goddard Ski Club. On January 20, 45 club members went by bus to Killington for three days of skiing and parties. For five members who had never skied before, there was a two-day GLM training course, and some of the club's better skiers met for lunch at the top of Killington Mountain.

A second trip is now in progress. This time club members have gone by car to Sutton, Canada, for five days of skiing.

Since the club was formed last fall, the Goddard Ski Club program has included the trips, regular meetings, a party at the Recreation Center, and a dry-land ski school for beginners. The club is organizing volleyball evenings and will also set up year-round activities such as hikes and mountain climbs, bike hikes, and whatever else the membership shows an interest in. For information on activities call a club officer: President, Jay Oberfield on ext. 4323; Vice President, Howard Wright on ext. 4685; Secretary, Tina Perez on ext. 6960; or Treasurer Jim Christo on ext. 6367.

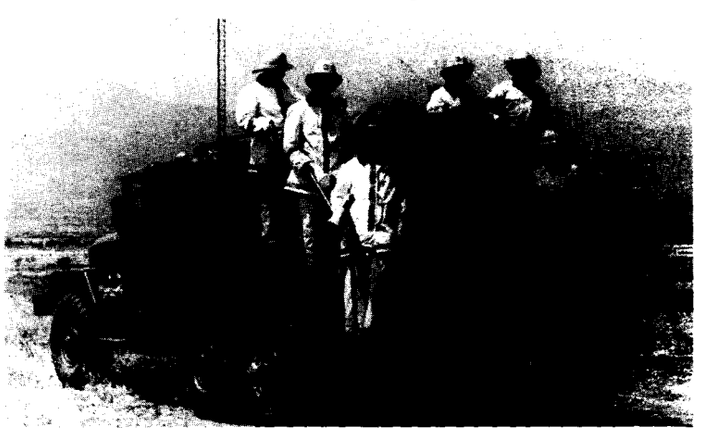
SNOW-TIME AT GODDARD. After months of spring-like winter weather, the season finally produced about two inches of wet snow on February 2. Employees in Building 18 made the most of the occasion and built this snowman during their lunch period.

MARVIN S. MAXWELL (left), Head of the Data Management Section and Irving B. Lowen hold parts of a Scanning Celestial Attitude Determination System (SCADS) like the one now operating on Explorer 45 (SSS). Lowen and Maxwell first developed the SCADS back in 1965 to determine the three-axis (pitch, roll and yaw) attitude of a satellite to an accuracy of 0.1 degrees or better. Similar SCADS have been flown on ATS 3, OSO 7 and SAS 1.

GODDARD AROUND THE WORLD

News from Santiago

TECWYN ROBERTS, Goddard Associate Director for Systems, Networks Directorate, is briefed by Santiago station personnel during his visit to the South American stations last fall. From left are Eduardo Díaz, Station Senior Manager; Boanergue Ormazábal, Assistant Manager, Technical Operations; Harry McKeehan, Head of Goddard's International Networks Office; Mr. Roberts, Andy Wilson (seated) of RCA, and Walter Gothe, Technical Support Manager.



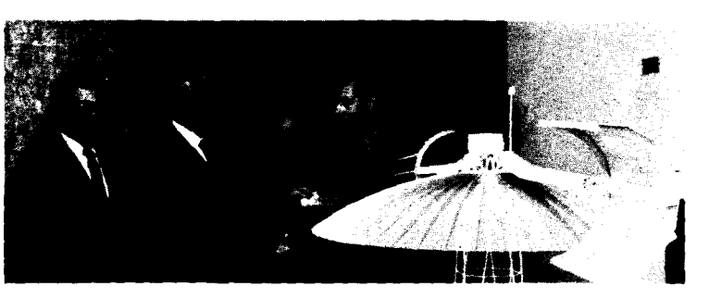
DO-IT-YOURSELF rose to new heights at the Santiago station when a local design and fabrication team produced this station fire truck from a surplus Army 6 by 8 truck and pumping equipment provided by Goddard. One of the shift fire teams is shown here (from left): Carlos Atkinson, Louis Plaut, Gustavo Mery, Rafeal Meza, Fernando Agurto with Roberto Prieto, station Safety Supervisor, and Benito Acevedo who maintains the vehicle.

A THIRTEEN-YEAR ERA ended when Eduardo Díaz Araya (left) assumed the Duties of Senior Manager at Santiago, relieving Anthony J. Hoogenboom of Bendix. The University of Chile has assumed maintenance and operation responsibility for the station, while Bendix continues to be represented by seven technical advisors serving as advisory staff to Station Director Chester H. Shaddeau, Jr.

Plans for LSI-MSI Testing

The Quality Assurance Division plans to obtain facilities to test large scale integrated circuits, a new breed of microcircuits. Large-scale-integration (LSI) is a method of construction whereby thousands of semiconductor devices are formed in a single chip to provide functions previously requiring hundreds of integrated circuits. In the photograph the dramatic reduction in size using this technology is shown. This new device will require a completely different type of test facility, normally using a computer to choose the tests and to keep track of the data obtained from the thousands of tests needed to evaluate one part.

The Inspection Section of QA Division plans to survey the scientists and engineers at the Center ot determine their future uses of integrated circuits. Although this survey is mainly directed toward large-scale-integration and its predecessor, medium-scale-integration, the Inspection Section is very interested in learning about uses of more conventional IC's using basic bipolar construction and complementary metaloxide-semiconductor (CMOS) construction. Anyone who is a user of integrated circuits is urged to contact Winslow Womack (5625) so that all project needs will be considered in QA's plans to provide test facilities at the Center.



ROBERT MARTEL, a Fellow Engineer of the Westinghouse Electric Corp. presently on assignment with the Synchronous Meteorological Satellite System here at Goddard, received an award from NASA for submitting a Tech Brief entitled "A Pseudo Random-Access Synchronous Meteorological Satellite System," while he was assigned to the ATS Project. Pictured are (from left) Eric Metzger, ATS Ground Systems Manager; Harry L. Gerwin, ATS Project; Chuck Sargent, Manager of FIS at Westinghouse, Mr. Martel and William L. Pridgen, Manager of FE&S at Westinghouse.

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Editorial Staff

Nancy Mengel Jim Kukowski

Mrs. Patricia Ratkewicz, Ext. 4141