GODDARD NEWS

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER

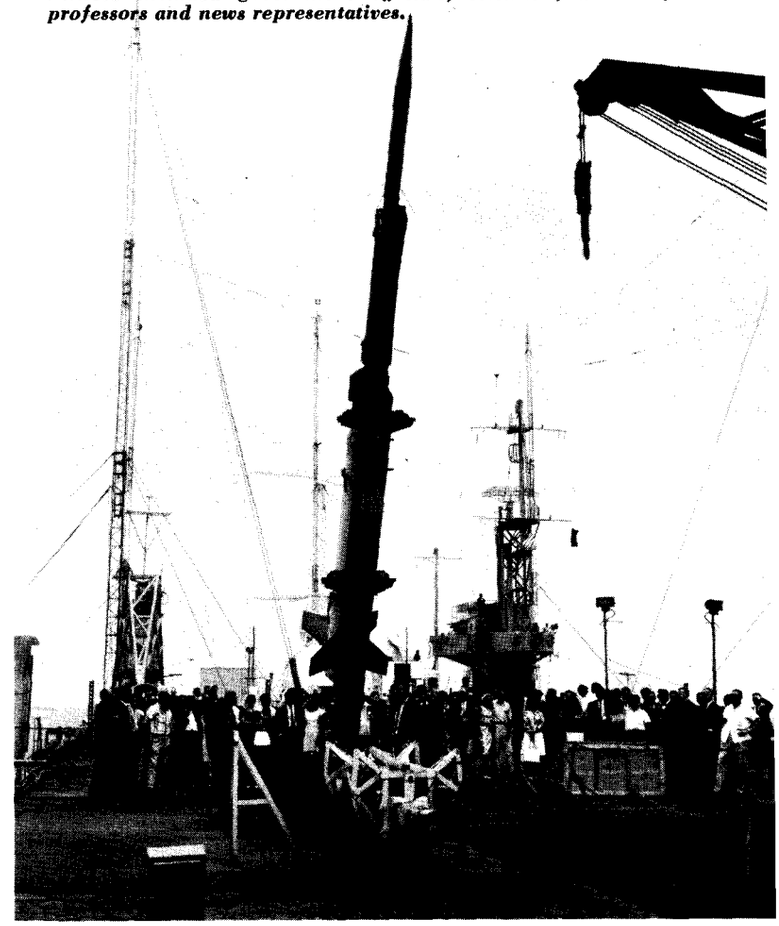
GREENBELT, MARYLAND

VOLUME IX, NUMBER 3 MAY 17, 1965

EUROSPACE GROUP AT GODDARD

ASTRONAUT JOHN GLENN is shown briefing some 117 members of EUROSPACE while touring Goddard during their second annual USA/European space conference. EUROSPACE is the principal aerospace trade organization in Europe, with 109 active and corporate members from nine countries and ten corresponding members from the United States. Purpose of the conference was to bring together top industrial leaders from European and United States aerospace companies to review the problem which the evolution of space technology poses for the space industry, both in Europe and the United States.

"OPEN HOUSE" aboard the USNS Croatan in Lima, Peru. Visitors included government officials, scientists, university professors and news representatives.



NASA SEA-GOING PLATFORM ENDS LAUNCH EXPEDITION

NASA recently completed a successful expendition of launching scientific experiments off the west coast of South America when the sea-going launch platform, the U.S. Naval Ship Croatan, arrived in Valparaiso, Chile.

A total of 77 sounding rockets were sent aloft from the deck of the converted escort carrier, operated under contract for NASA. Forty-five of the payloads were flown on vehicles of the Nike-Cajun and Nike-Apache class, and 32 were single-stage meteorological rockets.

Firings occurred at various positions from 5 degrees north to 60 degrees south of the Equator. Five experiments were conducted at or near the 60th parallel at about 78 degrees West Longitude. The project is part of the NASA sounding rocket program being conducted during the 1964-65 International Quiet Sun Year (IQSY) when solar flare and sunspot activity is at a minimum. Expedition data will be correlated with the findings of scientists throughout the world who are studying IQSY phenomena.

Experiments were conducted from the ship by 11 teams of researchers representing Goddard, Langley Research Center, and other federal agencies. Scientists from Peru, Chile, and Brazil participated as observers at various times during the expedition.

The ship was visited at Valparaiso by South American government officials, scientists, university professors and news representatives.

The project is under the overall direction of NASA's Office of Space Science and Applications. NASA's Wallops Station has project management for the mobile launch expedition.

Most of the Wallops personnel and the scientists who participated on the last leg of the journey debarked at Valparaiso to fly home.

Many Goddard people figured prominently in setting up

(See Page 2)

(From Page 1)

Sea-Going Platform

the experiments, including Dr. Keith Burroughs, Dr. Neil Davis, John Stolarik, Dr. Arthur Aiken, Dr. Thomas L. Aggson, Leo J. Blumle, Giles Spaid, Roy Hagemeyer, Bill Daniels, Gordon Talley, Carl Seddon, Robert Bourdeau, Dr. James Heppner, and Wendell Smith.

Two Goddard engineers from Ed Bissell's Sounding Rocket Instrumentation Section: John I. "Bud" Hudgins, Jr. and James R. Lease were responsible for certification of payload, readiness for flight, and liaison between the experimenters and the Wallops Mobile Range.

Bud Hudgins said, "The Rado-Doppler system, invented by Goddard's Carl Seddon, successfully tracked 21 vehicles during the three-month cruise. The vehicles carried experiments furnished by Goddard's Aeronomy & Meteorology Division and the Space Sciences Division."

Jim Lease, who handled the Sounding Rocket Branch commitments, reported: "The operation was a complete success, due primarily to the cooperation of all personnel involved."

The USNS Croatan, her three-month mission for NASA completed, has returned to the United States for removal of scientific equipment to resume her normal mission of worldwide cargo operations for the Navy's Military Sea Transportation Service.

***BRIEFING** of press, scientists and other visitors aboard USNS Croatan at Lima, Peru. From left are Captain Gunnar Johnson, ship's captain; Robert L. Krieger, Wallops Station Director; Robert T. Long, Wallops Director of Launch Operations; and Cesar Matto, Administration Officer of the STADAN station at Ancon, Peru.*

***CHECKING PAYLOAD** prior to launching the sounding rocket from aboard the USNS Croatan are three Goddard men: (from left) Dr. Thomas L. Aggson, Dr. T. Neil Davis, John Stolarik and Wallops technician, George Cutler.*

Meet Our People

This is another in a series of articles on Goddard personalities

Dr. Joseph W. Siry

Dr. Joseph W. Siry, Head of Goddard's Theory & Analysis Office (T&DS), has won recognition in this country and abroad for outstanding contributions to various fields of space research.

He came here in November 1958 as Head of the Theory & Planning Staff, Vanguard Division, when this facility was called the Beltsville Space Center. Prior to this he had been Head of Project Vanguard's Theory & Analysis Branch, and formerly had served as head of the Theoretical Analysis Section of the Rocket Sonde Research Branch of the Naval Research Laboratory.

Dr. Siry received the Arthur S. Flemming Award in 1960 as one of the ten outstanding young men in Federal service. He has written chapters for several books, as well as papers and reports on a number of subjects, including topology, rocket upper-atmosphere research, the ionosphere, cosmic rays, weapons systems, rocket launching vehicles, optimization, orbit determination, attitude determination, upper atmosphere densities, and systems analysis.

He is currently responsible for orbit determination and attitude determination for many types of satellites, including meteorological, scientific and communications satellites. His responsibilities include mission and systems analysis, orbit design and selection analysis, as well as launch-window and tracking systems analysis.

Dr. Siry, a native of New York City, received his B.S. degree in physics from Rutgers University and his M.A. and Ph.D. in mathematics from the University of Maryland. He served as a Lieutenant in the Navy from 1942 to 1946. He taught graduate courses in mathematics at the University of Maryland from 1953 to 1955. He served as a member of the U. S. delegation to the U. S.-U.S.S.R. negotiations on Cooperation in Space held in Rome in 1963. He is currently serving as Chairman of the Astrodynamics Committee of the American Institute of Aeronautics and Astronautics.

He lives at 4438 42nd Street, N.W., Washington, D. C., with his wife, Jennie, and two children: JoAnne Michaele, 17, and Joseph Michael, 9.

INSIDE GODDARD

GODDARD SPACE FLIGHT CENTER / GREENBELT MARYLAND

May 17, 1965

Win $500! Enter the "NASA Cost Reduction Slogan-Symbol Contest"

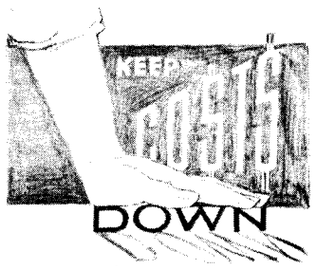
That's what you'll win if you submit the best slogan and symbol during Goddard's contest, running May 17 through May 28. The first prize is $250 for the best slogan and $250 for the winning symbol. You may submit both or either.

But that's not all! It's possible for you to win an additional $1000—making a total of $1500 in all—if your winning slogan and symbol are judged best among entries from all other NASA centers. This will be decided later in a NASA-wide contest to be held in July.

In announcing the contest, Dr. Goett said: "All employees are urged to participate in this contest. Prizes will be awarded for the best submissions by GSFC employees of either a slogan, a symbol, or both. The winning entries at Goddard will be placed in competition with the winners from other centers for grand prizes. The final winning slogan and symbol will be used throughout NASA to publicize and promote the NASA Cost Reduction Program."

The second prize is $100 each for symbol or slogan. And third prize is $50 each for a slogan or symbol.

Don't delay—enter the contest today! Submit a single idea or several entries if you like. If you should misplace your entry blank (all Goddard employees will get announcements and entry forms), simply contact the Cost Reduction Office, Building 8, Room 603, Code 206, extension 6193.



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Through
Payroll Savings

"Goddard Queen" Finalists —Now Being Selected

Nancy Green, Aeronomy & Meteorology Division, has already been selected to represent the Space Science & Satellite Applications directorate in the final judging of the "Goddard Queen 1965/66" contest to be held June 4 at the Goddard Spring Dance.

The other three finalists—one each representing the Office of Administration, Office of Technical Services, and the Tracking and Data Systems directorate—will be announced shortly.

Meanwhile, take a good look at your division's candidate for "Goddard Queen 1965 / 66." You'll find all division finalists in each directorate pictured on Pages 2 and 3.

And don't forget—you'll want to be present for the final judging at the Goddard Spring Dance. It will be a big event, the finest music, continuous dancing from 9 p.m. to 2 a.m., carnations for all the ladies, set-ups furnished with the price of admission: only $3.50 per person. It's truly a "don't-miss" affair in the spacious ballroom of the exciting new Washington-Hilton Hotel.

Needless to say, the tickets are selling fast, so get yours at your earliest opportunity. There's only a limited supply!

Nancy Green

Dedication Of New "Robert H. Goddard" Jr. High School

GUEST OF HONOR was Mrs. Robert H. Goddard, widow of America's rocket pioneer, during dedication ceremonies held recently at the new Lanham, Maryland, school named in honor of her late husband. Next to Mrs. Goddard is Eugene W. Wasielewski, Goddard's Associate Director. At right are William S. Schmidt (holding portrait), Superintendent of Prince Georges County Public Schools, and Ronald E. Mortimer, Principal of Robert H. Goddard Jr. High School.

HERE THEY ARE! All Division Finalists

Office of Administration

Leslie Richards

Elaine Young

Janet Frye

Julia Hanes

Charlotte Payne

Office of Space Science and Satellite Applications

Anna Marie Yech

Lila Thompson

Lucille Loche

Marla Hoke

Gail Scott

Lois Gerson

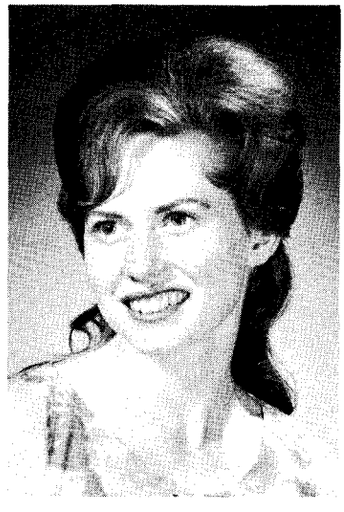
In The "Goddard Queen 1965/66" Contest!

Office of Tracking and Data Systems

Jane Bonnar

Linda Bullis

Suzanne Patrick

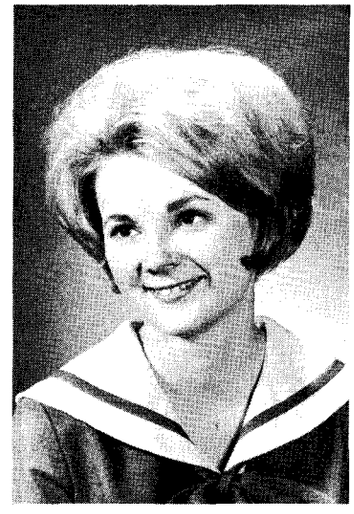


Ester Vermillion

Lola Nester

Sheryl Byrd

Office of Technical Services



Nola Trusen

Phyllis Parker

'Spareribs' Are League Champs

Robert W. Hutchison, Personnel Director, sent a memo to everyone in the Organization & Personnel Division (O&PD) about the good news. He said:

"If you have not heard about it already, you must have been out of the country, but it bears repeating. On April 12, our own division team, the "Spareribs," comprised of Sam (the superb) Falbo, captain; Evelyn (the excellent) Peters, Jim (the jolly) Keene, and Howard (the hurricane) Berthold beat the "Pin-Busters" for first place, the money, the trophies, and our eternal admiration." "Spareribs" are now champs of the "Guys & Dolls" Tenpin League.

"SPARERIBS," champion team of the "Guys & Dolls" Tenpin League. From left are Howard Berthold, Evelyn Peters, and Sam Falbo, team captain. Not shown, Jim Keene. They are the O&PD team.

Goddard's First Youth League Ends Season; High Hopes for Next Year

The first Goddard Youth Duckpin League climaxed the bowling season May 1, with a gala banquet at Goddard's Recreation Center. Attendance included the bowlers, parents and guests and Dr. Goett and his family. The festivities were highlighted with the presentation of awards by Dr. Goett's nine-year-old daughter, Lisa. Each of the 16 regular bowlers received a trophy commemorating Goddard's first youth league and the following special awards were made:

First Place Champions—Lucky Pins, Team #1: Ray Smith, Gwen Propst, Mike Beckner, and Penny Moran.

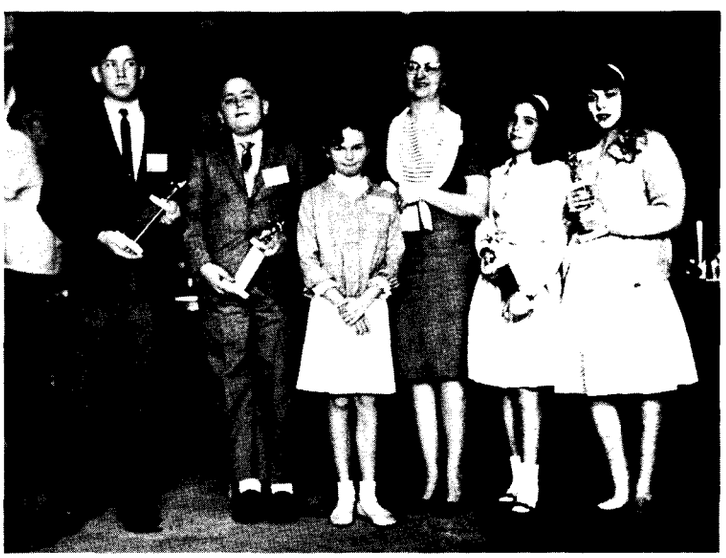
High Average:	Barbara Becker	90	Ron Husey	97
High Spares:	Susan Smith	76	Ron Surgen	73
High Strikes:	Chris DeLauter	11	Frank Zook	27
High Set:	Gwen Propst	248	Ray Smith	358
High Game:	Penny Moran	128	Rickey Quigley	121

The banquet and awards were made possible by the Goddard Employees Welfare Association and the concerted efforts of Alberta Moran, Laura Smith, Joe Manning, and Coaches Peggy Becker and Geene Moran.

Although the bowlers and the league were relatively small, competition was fierce. The championship was not determined until the twelfth frame of the last game of the season, when the Lucky Pins finally prevailed. Thirteen of the sixteen regular bowlers improved their averages during the season, Chris DeLauter to the tune of 33 points.

Interest in the league continually increased throughout the season so that even at this early date, plans are being formulated for a much larger participation this fall. All Goddard youngsters aged 9 thru 15 are eligible, and application may be made by calling Peggy Becker, extension 4686, or Barbara Shavatt, extension 4498.

MEMBERS OF GODDARD'S FIRST Youth Duckpin League. First row, (left to right) Mike Surgen and Randy Propst. Second row, (left to right) Gwen Propst, Barbara Becker, and Teresa Wall. Third row, (left to right) Sherry Levin, Susan Smith, Chris DeLauter, and Penny Moran. Fourth row, (left to right) Ron Surgen, Jr., Mike Beckner, Ray Smith, Ron Husey, Frank Zook, Rickey Quigley. Not shown, Joe DeLauter.



FIRST PLACE CHAMPIONS (left to right) Ray Smith, Mike Beckner, Lisa Goett, who made the presentations; Peggy Becker, League Coach; Penny Moran, and Gwen Propst.

PEGGY BECKER, coach for the Youth Bowling League, poses with the trophies that were made possible through Goddard Employees Welfare Association.

← Goddard Newcomers →

Office of Public Information

Joan M. Bethke

Financial Management Division

Linda C. Burdsall
David A. Reuben

Theoretical Division

John Philpotts

Network Engineering Division

Alice Cornes

Procurement Division

Karen A. Givens
John J. French
Lewis S. Sharpe

Management Services & Supply Division

Charlotte E. Grego

Goddard Launch Operations Branch (Cape)

Robert C. Kemerait

Experimental Fabrication & Engineering Division

John F. Osantowski

Data Systems Division

Helen M. Zug

NASA Communications Division

Allen W. Akerson
Stanley D. Chilson

Joint U. S./Brazilian Sounding Rocket Program

Through an agreement between the Brazilian Space Commission and NASA to cooperate in a scientific sounding rocket program, eight Brazilian engineers and technicians are presently receiving training at Goddard and Wallops Island.

The project, part of NASA's continuing program of cooperative space research, will contribute to observance of 1965 as International Cooperation Year.

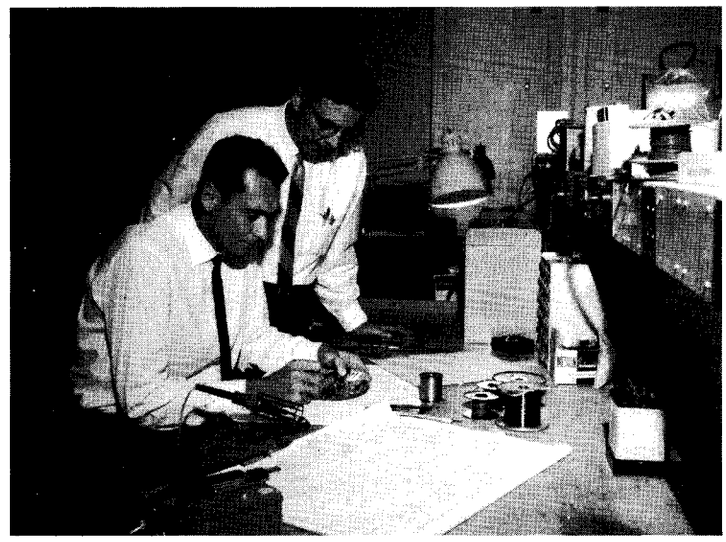
Under the agreement, NASA will provide and the Brazilian Space Commission (CNAE) will launch two sounding rockets from Natal, Brazil. CNAE will provide the launching range. The scientific payloads will be constructed by Brazilian technicians at Goddard.

CNAE and NASA will combine to provide the ground support equipment required for the launchings. In addition, NASA will launch one instrumented sounding rocket from Wallops Island, Va., in a complementary experiment.

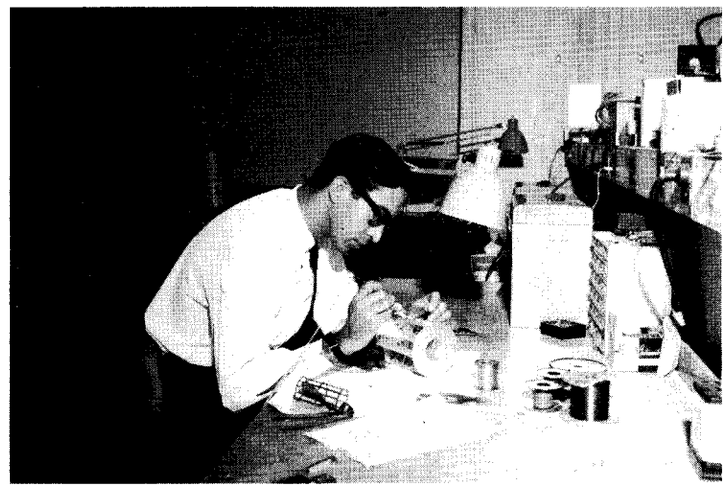
Brazilian engineers and technicians at Goddard include: L. Gylvan Meira and Pedro Ivo Seixas. Their training is under the guidance of Giles Spaid of the Planetary Ionospheres Branch, headed by Robert E. Bourdeau. Under the supervision of Edward E. Bissell, Jr., head of the Sounding Rocket Instrumentation Section are: Jose Arildo Macedo Salgado, and Paulo Del Vaux. Presently in training at Wallops are the remaining four members of the Brazilian team: Moacyr D. Tedesco, Group Leader; Heitor Borges, Jr., Ivan J. Miranda, and Satoshi Yokota.

The agreement provides for analysis of data and publication of results by both Brazilian and U.S. experimenters. The results will be made available to the world scientific community.

The purpose of the joint Brazilian-American program is to investigate the lower regions of the ionosphere with emphasis on the effects of cosmic rays in this region. This will be done by comparing the electron and ion densities with solar radiation in the Lyman-Alpha range and other data that are gathered in Natal and Wallops Island.

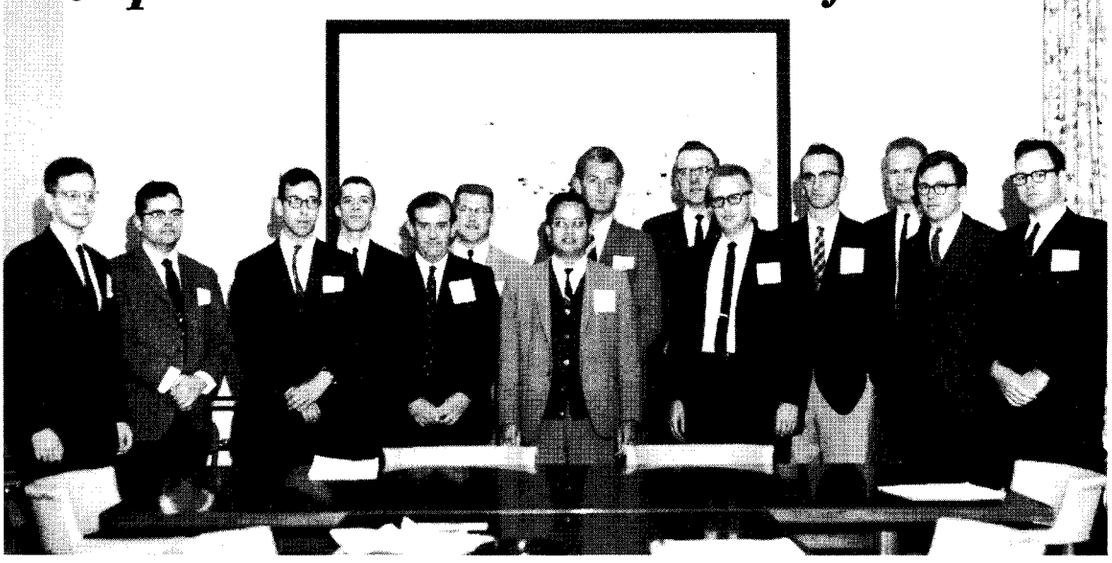


PEDRO IVO SEIXAS is wiring an electrometer for ion density sensor, while supervisor Giles Spaid watches.



L. GYLVAN MEIRA (above) wires a VLF (very low frequency) receiver for the measurement of electron density.

Jupiter Burst Observers Conference



A GROUP OF RADIO ASTRONOMERS recently met at Goddard for the "Jupiter Burst Observers Conference." Observatory reports presented during the two-day conference confirmed the previously reported effect of the satellite "Io" on the radio emission of Jupiter. Summarizing the conference are (from left): F. R. Zabriskie, K. L. Franklin, A. Bozyan, J. K. Alexander, J. A. Gledhill, D. Obitts, R. V. Bhonsle, C. H. Barrow, J. Witting, W. M. Sherrill, R. R. Weber, G. A. Dulk, M. A. Gordon, and W. E. Brunk. Not shown: T. D. Carr, G. R. Lebo, W. C. Erickson, M. M. Komesaroff, E. K. Bigg, N. F. Six, R. G. Stone, H. H. Malitson and L. W. Brown.

Recent Technical Publications Authored by Goddard Staff

R. G. Langebartel, "Liouville's Equation and the n-Body Problem," NASA Technical Report R-217, April, 1965.

M. P. Thekaekara, "A Survey of the Literature on the Solar Constant and the Spectral Distribution of Solar Radiant Flux," NASA Special Publication SP-74, April, 1965.

R. E. Samuelson, "Radiative Transfer in a Cloudy Atmosphere," NASA Technical Report R-215, April, 1965.

W. Korvin and J. Steckel, "A Vertical Test Range for Antenna Radiation Measurements," NASA Technical Note D-2752.

East Grand Forks, Minnesota—

STADAN Station Fully Operational

The worst flood in fifteen years recently hit East Grand Forks, Minnesota, where Goddard's Richard M. "Dick" Waetjen heads up the STADAN station.

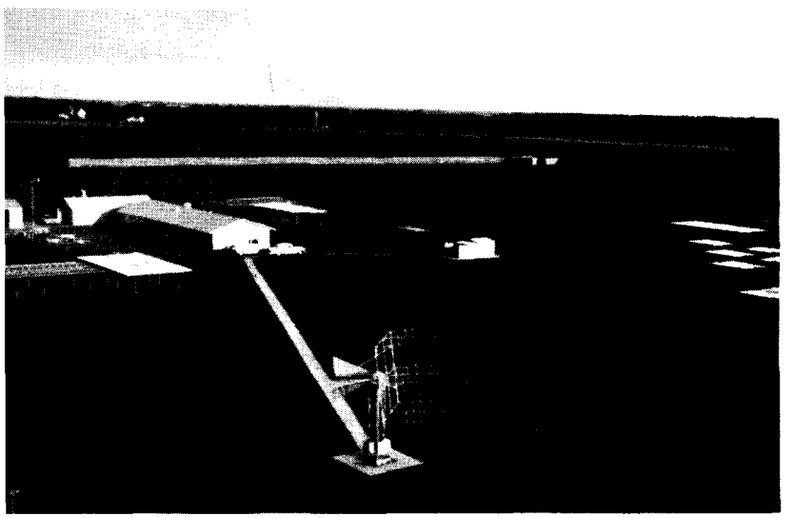
Reporting from the disaster area, Mr. Waetjen said:

"Since Grand Forks is at the junction of the Red and Red Lake Rivers, all it took to precipitate a flood was a few days of warm weather melting the ice, accompanied by heavy rain and ice jams on both rivers.

"The water level rose over thirty feet—above the first floor level of most homes—to within six inches of the 1950 all-time high of 45.4 feet.

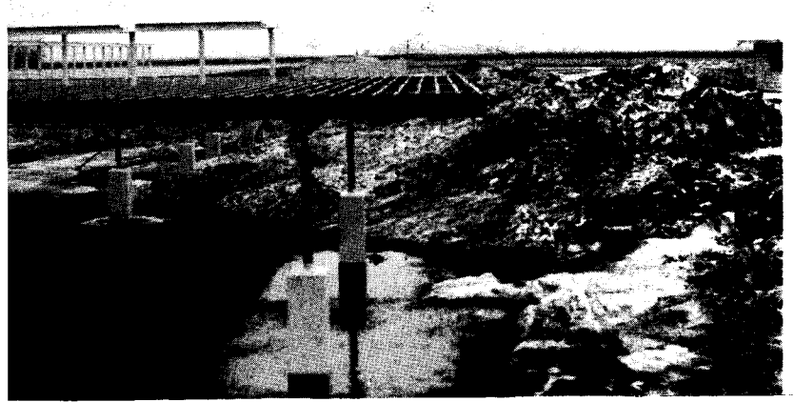
"Large residential areas in Grand Forks, East Grand Forks, and several nearby towns were flooded, as well as highways and bridges in the area. Three station employees and their families had to flee when the water reached their homes. Several others could not come to work because the roads were impassible. Station employees assisted in erecting dikes and helped in every way possible.

"Despite the drawbacks the station was fully operational during the flood, with only two to three men on a shift instead of the usual five. In one instance, one engineer and a technician took twelve satellite passes during an eight-hour shift, handling over double the normal work-load.

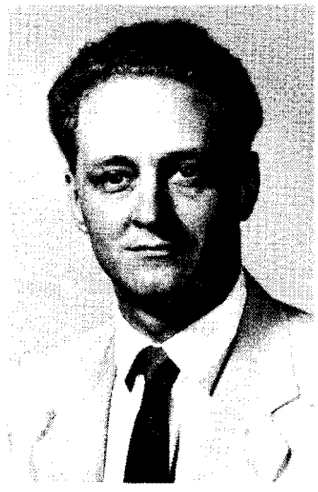


BEFORE THE FLOOD. The STADAN station at East Grand Forks, Minn., in normal times.

WATERS RISING in early April on the grounds of the East Grand Forks STADAN station. Snow banks are 6 feet high. Ground is frozen until early May. A few rains with melting ice in this flat country cause both rivers to overflow.



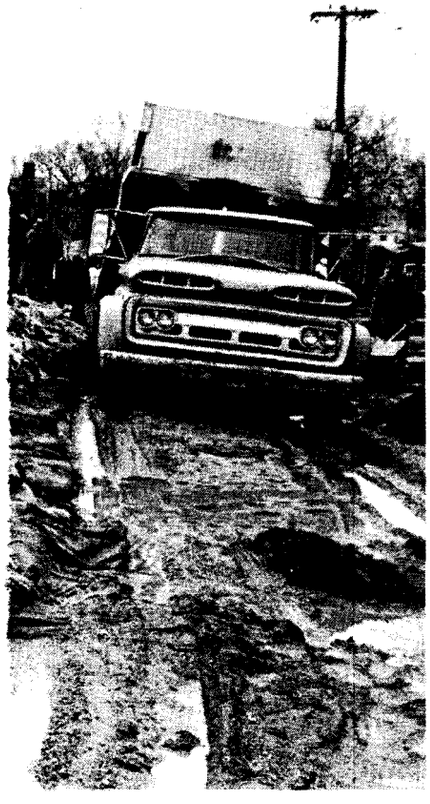
During Flood



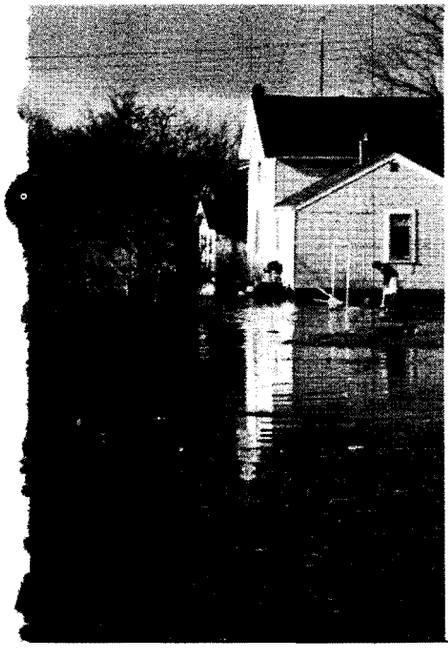
Richard M. "Dick" Waetjen, STADAN Station Director

HELICOPTER VIEW of East Grand Forks during the recent flood. Red Lake River and Red River join at right.

SANDBAGGING OPERATIONS at dike in East Grand Forks. Water has risen above the first floor level of most homes.



EMERGENCY dike at East Grand Forks, Minnesota.



FLOODED STREETS in the Riverside Park area of Grand Forks. Many homes had to be abandoned by residents.

ERECTING DIKES of sandbags at East Grand Forks. Farmers supplied their potato bags when other bags ran out.

Chosen For AIAA Committees

The American Institute of Aeronautics and Astronautics (AIAA) has named four Goddard men to membership in 1965 AIAA Technical Committees.

These committees are the technical backbone of the AIAA and membership in them indicates the individual's eminence in his professional specialty.

Dr. Joseph W. Siry
Head, Theory & Analysis Office (T&DS)

Eugene W. Wasielewski
Goddard's Associate Director

Eugene W. Wasielewski was made a member of the Management Committee. Scope: Discussion of management problems unique to aeronautics and astronautics, particularly applied to the problems arising from the management of research and engineering projects. This excludes such subjects as labor relations, etc.

Dr. Joseph W. Siry was named chairman of the Astrodynamics Committee. Scope: The determination, improvement, prediction and physical adjustment of trajectories in space; space navigation and rendezvous; re-entry trajectories; attitude; optimization; perturbation theories and expansions; differential correction and statistical processes; observation reduction.

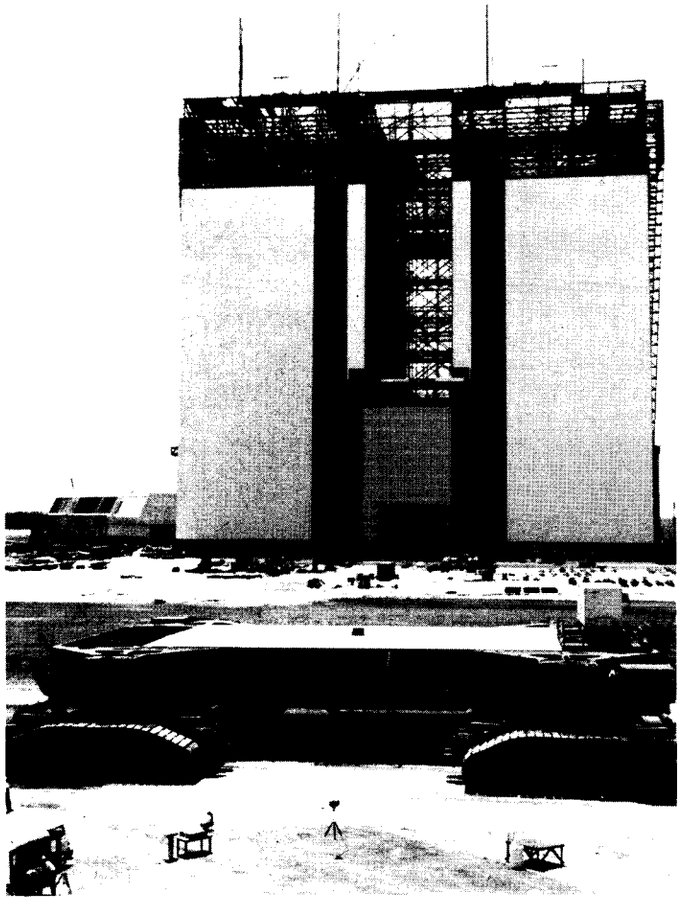
Dr. Leslie H. Meredith was appointed to membership in the Space and Atmospheric Physics Committee. Scope: Physics (and chemistry) of the matter and fields in space and of the atmosphere about celestial bodies including both theoretical and experimental techniques for observing and understanding all naturally occurring phenomena pertinent thereto.

Milton Schach was chosen as a member of the Thermophysics Committee. Scope: Study and applications of the properties and mechanisms involved in the thermal energy transfer within and between solids and between an object and its environment, particularly by radiation. Study of environmental effects on such properties and mechanisms.

Dr. Leslie H. Meredith
Chief, Space Sciences Division (SS&SA)

Milton Schach
Head, Thermal Systems Branch (SS&SA)

New Transporter For Saturn V



CRAWLER-TRANSPORTER, shown at Launch Complex 39, Kennedy Space Center, Merritt Island, Fla., will carry Saturn V moon rockets from the Vehicle Assembly Building (in background) along a 3-mile specially built roadway to the launch pad. The crawler, which weighs six-million pounds, is 131 feet long and 114 feet wide. It moves on four double-tracked crawlers, each 10 feet high and 40 feet long. Essentially it is a modified version of heavy crawlers developed for strip mining operations. Tests show it will transport the 350-foot Saturn V and Apollo with ease.

GODDARD NEWS

MAY 17, 1965

"It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow."
—DR. ROBERT H. GODDARD

The Goddard News is published biweekly by the Public Information Office of the Goddard Space Flight Center, National Aeronautics and Space Administration, Greenbelt, Md.

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GODDARD SPACE FLIGHT CENTER

GODDARD INSTITUTE BULLETIN

INSTITUTE FOR SPACE STUDIES 475 RIVERSIDE DRIVE NEW YORK, N. Y. 10027

COMPUTERS: MAJOR TOOLS IN SPACE RESEARCH

(Editor's Note: The following report was prepared by Dr. Robert Jastrow and Dr. Albert Arking from an article written by them for the New York Times Sunday supplement on the International Federation for Information Processing.)

In 1965 we stand on the threshold of a new era in the research uses of computers.

Steady improvements in calculating speed and memory capacity of the computer have finally produced a subtle, qualitative change in its character. We have the prospect before us, in the machines coming on the market in 1966 and 1967, of using the computer not as an abacus, but as a laboratory for the performance of experiments. This transformation in the character of the computer is particularly important in the space sciences.

How can a computer be equated with a laboratory? The understanding of this peculiar statement requires some knowledge of the way in which the physicist looks at the natural world.

According to the research of the last 50 years, all matter is composed of a few fundamental building blocks—the neutron, proton, and electron. These particles are cemented together in combinations of various sizes to form the hierarchy of structure in the natural world, ranging from the atomic nucleus to such massive bodies as planets, stars and galaxies. The organization of units of matter, and their interactions with one another, are controlled by four basic forces of nature—a strong and a weak nuclear force, the force of electromagnetism, and the force of gravity. Most powerful of all is the strong nuclear force, which cements neutrons and protons together into the tightly bound nucleus of the atom. Next is the electromagnetic force, which is approximately 100 times weaker than the nuclear force. Least powerful is the force of gravitation; this frail agent keeps the moon in orbit around the earth, the earth and the other planets revolving around the sun, and the sun and other stars clustered together in our Galaxy.

All experiments in the natural sciences are designed either to study the fundamental building blocks of matter and the basic forces which control their interactions; or, using existing knowledge of the basic forces and particles, they are designed to investigate large numbers of these particles, whose collective behavior is too complex to be readily understood in terms of the individual units.

With these circumstances in mind, let us re-enter the laboratory. In a laboratory experiment a sample of matter is manipulated to observe its response to artificial disturbances under carefully controlled conditions. If the physicist is motivated by a desire to learn more about the fundamental building blocks of matter, and the forces which act between them, he will choose for this experiment a very simple collection of particles whose individual responses can be observed. During the last 30 years, nuclear forces have been studied in this way by experiments performed with high-energy accelerators.

DR. DILHAN EZER, left, a research associate from Turkey who is working on stellar evolution, discusses a problem in stellar structure with programmer Lynne Averill in the Goddard Institute's computing facility.

On the other hand, the experimenter may have an adequate knowledge of the basic forces and particles, but be seeking more information about the behavior of the whole ensemble of atoms as a unit. The biochemist, for instance, seeks to unravel the tangled sequence of chemical reactions between large groups of atoms, which make up the business of life.

These procedures have worked exceedingly well in both types of situations. Science has achieved its greatest successes through the development of such techniques for experimentation under controlled conditions in the laboratory.

But in the space science program, opportunities for this kind of laboratory experimentation are generally not available. The object under study in space science, which may be an entire star, a planet, or the atmosphere of a planet, is too large to be brought into the laboratory or to be manipulated artificially in its native state.

Consider, for example, the weather. In order to arrive at an understanding of the causes of weather, we must experiment with the atmosphere by adding heat to one part of it under controlled conditions, and observing its response. But when it is observed that one ordinary hurricane releases the energy of 10,000 hydrogen bombs, we see that it is not feasible to carry out such experiments on the weather.

The new computers coming on the market have, for the first time, a sufficient memory capacity so that we can store in one of these machines a relatively complete description of the atmosphere, including atmospheric temperature and pressure and ground conditions all over the globe. We can also store the basic laws of physics which determine the response of the atmosphere to the energy received from the sun.

The computer can apply the basic laws to each part of the atmosphere, calculating the new conditions which will result from the extension of the existing atmospheric motions over a small interval of time. Then, with the new conditions as the starting point, the computer program again applies the basic laws to obtain the atmospheric conditions after a second small interval of time.

A million repetitions of this process may be necessary to follow the development of weather over a long period of time. The number of additions and subtractions can amount to 10 trillion simple steps for one such study. Only the computers now arriving on the market contain *both* the memory capacity required to store an adequately complete description of the atmosphere, *and* the speed necessary to complete this vast amount of arithmetic in a reasonable time. *(See Next Page)*

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With the new computers we will move much closer to our ultimate objective—which is to vary the regional input of solar energy and the conditions on the ground, by feeding different numbers into the computer, and, thereby, to determine, by machine calculations, the effect of these variations on global weather.

In such calculations, the computer is used as a means of carrying out an otherwise impossible experiment on the behavior of the atmosphere. The experiment is numerical, and does not involve actual molecules of air. Yet those molecules of air are in the computer, nonetheless, because the computer contains a complete electronic record of these properties stored in its memory.

Now let us transform this machine from an imitation of the earth's atmosphere to an imitation of some other body which we wish to study. There is a great deal of interest, for example, in the conditions which exist within the body of a star such as the sun. We may wish to study the history of the sun from the time of its formation, 4.5 billion years ago, to the present. Such a study yields information about the physical conditions which existed in the early years of the solar system, when the planets were formed.

An abundance of observational evidence indicates that the sun and other stars are born in a natural condensation of the gas and dust which fill space. It is thought that planets are formed in a similar manner, as smaller condensations in the cloud of partly compressed gas which surrounds the star at the time of birth. Astrophysical evidence indicates that the formation of planets in this way is a frequent accompaniment to the birth of stars, and that planets are a commonplace feature of the universe.

In our solar system, it is believed that life developed on the earth about three and a half or four billion years ago, one billion years after the formation of the sun and the planets.

It is not clear how the transition occurred from a soup of inanimate matter made up of complex organic molecules, to the mysterious substance of life. It is possible that an understanding of this mystery may forever be denied us. Nonetheless, molecular biologists are making amazing progress toward a mechanistic description of the living cell in terms of chemical reactions. Scientists who are acquainted with the most recent advances in molecular biology and who have followed the developments relating to the evolution of the stars and planets, have a growing impression that a credible description of the origin of life on the earth may come out of the union of these two streams of inquiry.

It is important to realize that the early properties of the sun, and the physical conditions which existed on the earth in its first billion years, were almost certainly quite different from those that exist today. These differences play a critical role in our attempts to understand the development of physical life on this planet. Unfortunately, it is not possible to learn anything about the evolution of the sun and the planets by direct observation in the scale of human lifetimes. Hundreds of millions or billions of years must elapse before appreciable changes occur in the properties of a planet or a star. It is also not possible to apply outside forces to the sun or a planet and observe its response, in an analogue to a controlled experiment in the laboratory, because the energies required are, once again, beyond human manipulation.

We can, however, perform this laboratory experiment with a computer, provided we have a good enough knowledge of the basic laws which govern the properties of stars and planets. For this purpose we can use the same computer which previously imitated the earth's atmosphere. We can transform a high-speed computer from an imitation of the earth's atmosphere to an imitation of the sun or the planet earth, by erasing the description of air molecules which is recorded within the machine, and feeding into the computer a new set of punched cards which contains a description of the atoms of the star or a planet instead. In this way we make the computer change its character from a planetary atmosphere to a flaming body of gas, or a cold body of rock. When these changes have been made, the machine is now ready for service as a device which will yield information on the life history of the sun or the earth.

Knowing the laws of nuclear physics which generate the energy by which the sun burns, and inserting these laws into the machine, we must learn how the sun must have behaved. Knowing the properties of the materials which make up the earth's interior, we discover how the earth must have evolved since it first condensed out of the primitive solar nebula. In this way, with the aid of computers, we look backward into the history of the solar system to a time which preceded the existence of living organisms, and learn something about the physical conditions on the primitive earth which may have led to the appearance of man on the face of this planet.

Dr. William Hoffman

NEW APPOINTMENTS FOR INFRARED ASTRONOMY

Dr. William Hoffman, instructor in physics at Yale University and a WAE employee of the Goddard Center in New York, will join the Goddard Institute staff as a full time employee on June 20. He will conduct a combined theoretical and observational program in infrared astronomy.

Dr. Hoffman expects to conduct balloon flights with instruments, the critical element of the instruments being the use of an infrared detector cooled to liquid helium temperatures. The initial plans call for an all-sky scan with a resolution of 1.5 degrees.

He will collaborate with Prof. Neville Woolf, currently working with Prof. Martin Schwarzchild at Princeton University, on the Stratoscope project. Arrangements are being made which will permit Professor Woolf, who has been appointed to the Faculty of the Astronomy Dept. of the University of Texas, to divide his time between Texas and New York.

LECTURES

A. G. W. Cameron, Auburn Community College, Auburn, N.Y., March 25, ***"Stellar Evolution and the Origin of the Elements"*** and ***"Extraterrestrial Life."***

Derek Moore, University of Leeds, Leeds, England, March 30-April 2, ***"A Non-Linear Overstable Oscillator."***

Patrick Thaddeus, University of West Virginia, Morgantown, W. Va., April 2, ***"Recent Advances in Space Science."***

Hong-Yee Chiu, City College School of Engineering, New York, N.Y., April 6, ***"Foundations of General Relativity."***

Robert Jastrow, University of Rochester, Rochester, N.Y., April 6, ***"Lunar and Planetary Physics."***

Nicholas Panagakos, Scandinavian Club of New York, Brooklyn Heights, N.Y., April 7, ***"The Significance of Lunar Exploration."***

Robert Jastrow, Grumman Aircraft Corp., Bethpage, L.I., N.Y., April 14, ***"Lunar and Planetary Atmospheres."***

Nicholas Panagakos, Lions Club, Ridgewood, N.Y., April 20, ***"The Significance of Lunar Exploration."***

Richard Stothers, Yale University, New Haven, Conn., April 21, ***"Very Massive Stars."***

Robert Jastrow, National Science Teachers Assoc., University of Pittsburgh, Pittsburg, Pa., April 28, ***"A Prospectus for An Introductory Science Course."***

A. G. W. Cameron, The Catholic University of America, Washington, D.C., April 29, ***"Origin of Planetary Atmospheres."***

COLLOQUIA

April 9, ***"Possible Observational Tests of Cosmological Theories,"*** Dennis W. Sciama, University of Cambridge, England.

April 15, ***"Physical Processes Involved in the 26 Month Oscillation of the Mesosphere,"*** Richard S. Lindzen, University of Washington.

PUBLICATIONS

Cullen L. Inman, "Baryon Star Models," *Astrophysical Journal,* January 1, 1965.