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GODDARD NEWS

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

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Thirteen Goddard Scientists Join In Educational Meet

Thirteen Goddard scientists joined with educators representing more than 300 colleges and universities in studying the relationship between NASA and educational institutions in meeting national space goals.

Scientists from six other major NASA field centers participated in the nation-wide assembly, the first of educators and scientists to discuss the nation's space program. The conference was held in Chicago Nov. 1-3.

Specific purposes of the NASA—university conference were to inform university administrators and faculties of the scope and status of the program, explore how universities could help meet national goals in space exploration, and emphasize the growing need for better trained students and higher caliber research.

Dr. Robert Jastrow, director, Goddard Institute for Space Studies, spoke on "Developing Skills for Research in the Space Sciences."

Dr. John Townsend, Jr., assistant director for space sciences and satellite applications, was chairman during the special session on "Geophysics and Astronomy," in which the following Goddard scientists participated:

Ionospheric Research

Robert Bourdeau, head, planetary ionospheres branch, discussed rocket and satellite experiments designed to study the characteristics of charged particles with thermal energies (ionospheric particles).

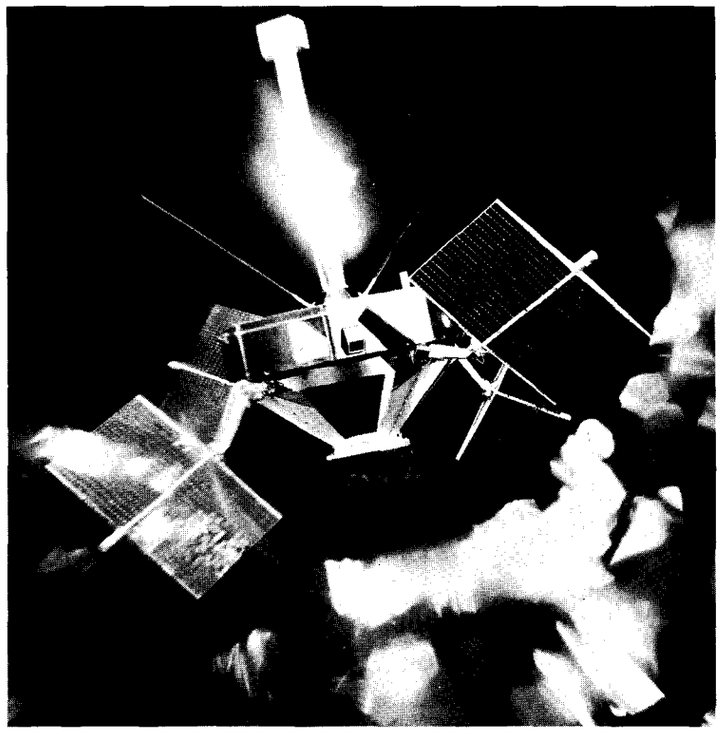
Particles and Fields Research

Dr. George Ludwig, fields and particles branch, discussed the solar production of cosmic rays and research studies of the interplanetary magnetic field.

Astronomical Research in Space

Dr. James Kupperian, Jr.,

(Continued on page 8)



PHOTOGRAPHED in its space environment prior to launch on Oct. 26 is the S-3b (Explorer XV) satellite.

Portable Brasilia Station Is Set Up for New Satellite

A completely portable ground station to obtain data from S-3b (Explorer XV) during perigee when its signals are the strongest was set up in record time in Brazil.

The station consists of two antenna and electronics trailers and a power generator van. The 62,000-pound load was flown to Brasilia, Brasil, aboard an Air Force C-133B, according to Arthur Lake, of the field support office of the operations and support division. The power van was picked up at Goddard and the trailers at the Antigua, West Indies, downrange station.

"The Brasilia station gives us coverage in the most efficient manner during a critical part of the satellite's orbit," said Harold Hoff, assistant chief of the operations and support division.

The other feasible way of obtaining the data would have been through use of an instrumented ship, but this presented logistics problems, he said.

The ground station is being operated by four Bendix contractor employees. It will operate as long as the satellite is transmitting, which is estimated to be 60 days.

Overall charge of setting up the station is under Fred Friel, Jr., chief of the operations and support division.

John Steckel, assistant head of the flight R-F systems branch, and Maurice Handegard, electronic technician in the integration branch, assisted in establishing the station and training the operators. Mr. Lake was in charge of movement of the station to the South American site.

Goddard to Host Industry Members of New Committee

Goddard will host members of NASA's newly established industrial applications committee in a special briefing and tour Wednesday.

Purpose of the visit is to further implement the industrial applications program at the Center and give members of the committee a chance to meet Goddard personnel and see the center's operations.

The industrial applications program represents the first major effort to turn the results of NASA research and development back to the civilian economy, according to Sam Keller, industrial applications officer at Goddard.

A principle purpose is to locate and document those ideas which may have value but tend to "get lost" in the rush to complete a project.

"The briefing and tour of the committee by Dr. Goett will be one of depth to emphasize technical work which could result in the transfer of government-funded technical know-how to the commerical economy," said Mr. Keller.

Top Leaders Here

Committee members consist of some of the top executives of American industry who advise the NASA administrator on the formulation of policy for the program.

Importance of the program is emphasized by the fact that

- 80 per cent of the professional and technical personnel engaged in research and development in the U.S. are working, directly or indirectly, on government programs and
- 70 per cent of all research and development investments are presently being made by the government.

Said Louis B. C. Fong, NASA industrial applications officer:

(Continued on page 8)

Jupiter's Mysterious Radio Bursts Continue to Puzzle Astronomers

By Prof. James Douglas

Professor Douglas is an assistant professor of astronomy at Yale university. He spoke Friday at the weekly Goddard colloquium program. A summary of his talk, "Radio Observations of Jupiter's Radiation Belts," is presented here.

Since the unexpected discovery in 1955 of strong 15-meter radio noise bursts from Jupiter, the giant planet has occupied a unique position of interest to radio astronomers and space scientists.

In addition to this sporadic decameter radiation, strong non-thermal radiation at decimeter wave lengths has been observed, as well as the normal thermal radiation expected of a black body of Jupiter's temperature. Intensive observations of the planet in all wave length ranges have been made since 1955, and many of the general features of the radiation are coming to be understood.

James Douglas

(Decimeter radiation refers to wave lengths in the short or centimeter region, while decameter wave lengths refer to the longer 10- to 30-meter radiation.)

A conference on the planet Jupiter sponsored by NASA and held at the Institute for Space Studies in New York City on Oct. 16-17 has underscored both the dramatic advances in understanding of the source of decimeter non-thermal radiation, as well as the puzzles remaining particularly with regard to the decameter radiation.

The key to the understanding of the decimeter radiation proved to be the prediction in 1959 and observation in 1960-61 of a giant radiation belt surrounding Jupiter. The observation of the shape, polarization, orientation and rotation period of this belt by the radio astronomy group at Cal Tech is a technological triumph of modern astronomy.

Based on this information, the decimeter radiation is considered to be produced by synchrotron radiation by relativistic electrons spiraling in Jupiter's magnetic field.

The size of the radiation belt is some three planetary radii. The planetary magnetic field required is some tens of gauss at the poles and the emitting electrons have a density of 10^{-2} to 10^{-3} per cubic centimeter with energies in the range of 5 to 75 Mev.

The flux of radio radiation associated with this belt seems correlated with solar activity, suggesting that the ultimate source of energy is associated with the solar wind with a relaxation time on the order of days to weeks rather than months to years.

Finally, it is clear that the radiation belt will have some effect on the observed decameter noise storms although the synchrotron process responsible for the decimeter radiation will not explain the sporadic lower frequency emission.

The mechanism of the decameter radiation is still a matter of some uncertainty with Cerenkov radiation and various processes which amplify existing thermal noise all being currently under consideration.

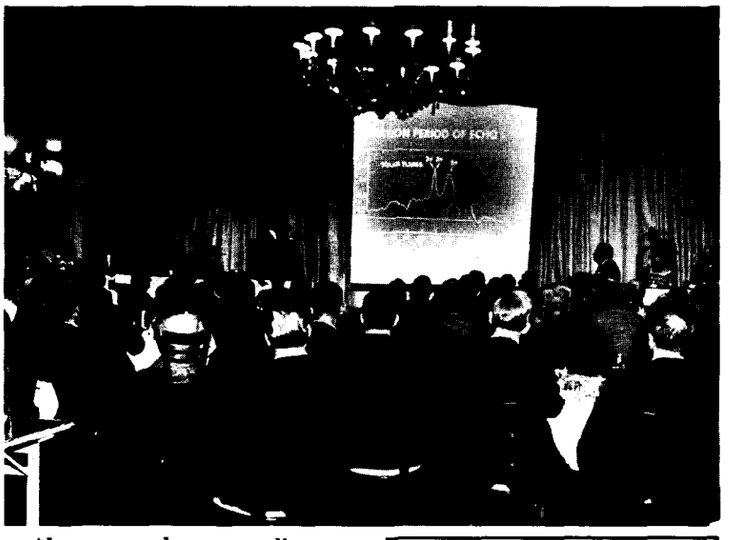
A rather complicated set of observed facts must be explained by any proposed mechanism; for example, a set of facts is sporadic, rather narrowband (2 to 5 megacycles) noise, polarized, emitted in three preferred directions relative to Jupiter's magnetic field with a tendency to drift infrequently in a distinctive way associated with the direction of the observer relative to this radiation directivity pattern.

Less firmly established are the detailed ways in which the radiation is correlated with solar activity, both on a short term (flares) and a long term (Sun spot cycle) basis, and the variation of polarization with time, frequency and direction of the observer relative to the radiation directivity pattern.

These latter two areas of observation are very important, but very difficult due to the low frequency of observation. Both the terrestrial ionosphere and hitherto unexpected magnetospheric or interplanetary propagation phenomena confuse the interpretation of observations.

The two varieties of non-thermal radio noise from Jupiter have thus stimulated theoretical work on the radiation properties of a planetary magnetosphere. Once understood, the interaction of Jupiter's magnetosphere with the interplanetary medium can provide a valuable probe of various solar wind effects, and the relatively low frequency of the decameter noise will permit sensative propagation experiments on both the interplanetary medium and the terrestrial magnetosphere.

MARYLAND'S CERTIFICATE of Distinguished Citizenship is awarded Dr. Harry Goett, Goddard director, for "organizing and operating the Goddard Space Flight Center as the nation's outstanding space science laboratory." Making the presentation on behalf of Gov. Millard Tawes is Marvin Brand, of Maryland's department for economic development. Occasion was the ninth annual east coast conference on aerospace and navigational electronics, of which Dr. Goett was the keynote speaker.



Above, members attending the aerospace and navigational electronics conference in Baltimore hear Dr. Goett discuss the results of Goddard space projects during the past three years.

Recent Technical Publications Authored by Goddard Staff

T. L. Cline, P. Serlemitsos and E. W. Hones (Institute For Defense Analyses). "A Double Gamma-Ray Spectrometer To Search For Positions In Space," NASA Technical Note D-1464, November 1962.

R. H. Wilson, "Rotational Decay Of The Satellite 1960 ETA 2 Due To The Earth's Magnetic Field," NASA Technical Note D-1469, November 1962.

F. O. Vonbun and W. D. Kahn, "Tracking Systems, Their Mathematical Models And Their Errors Part I—Theory," NASA Technical Note D-1471, November 1962.

F. C. Cain, I. R. Shapiro, J. D. Stolarik and J. P. Heppner, "Measurements Of The Geomagnetic Field By The Vanguard III Satellite," NASA Technical Note D-1418, October 1962.

Aerobee Measures Energy of Stars

A 200-pound scientific payload designed to measure the ultraviolet energy distribution of stars and check out instruments programmed for the Orbiting Astronomical Observatory satellite was launched from NASA's Wallops Island station, Va., last Monday.

Primary purpose of the flight was to obtain ultraviolet data from two "early-type" stars, Cononea Borealis and Ophiuchi. Both are comparatively young stars and are burning rapidly. Data on their energy distribution is needed as part of a star evolution study being conducted by the University of Wisconsin. An attitude control system developed by Goddard was used to "point" the payload at the stars.

The OAO instruments carried on the flight were three photometers developed by the University of Wisconsin's space astronomy laboratory. It marks the first time that OAO equipment has been flight tested. The OAO satellite is scheduled to be launched in 1964.

A two-stage, 25-foot-long Aerobee sounding rocket was used to launch the payload in a near vertical trajectory. The payload achieved an altitude of 116.2 statute miles, and impacted in the Atlantic Ocean. No recovery was planned.

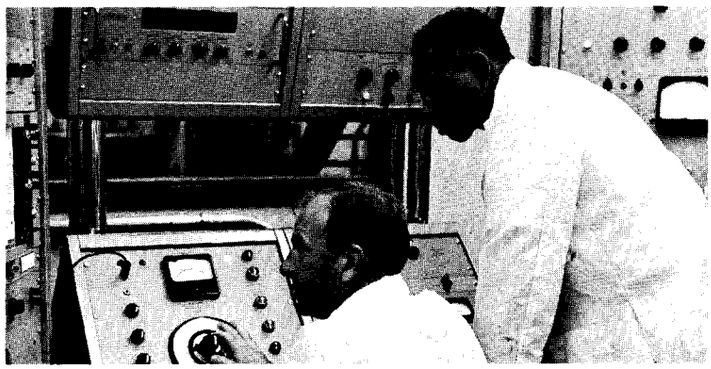
Dr. A. D. Code of the University of Wisconsin was the project manager. The Goddard project scientist for the experiment was Dr. James Kupperian, Jr.

COMING EVENTS

Lecture: Goddard Colloquium lecture, 3:00 p.m., Auditorium, Bldg. 3, Nov. 9—Dr. Sukumar Biswas, Space Sciences Div., "Composition of Solar Cosmic Rays".

Misc: Goddard Astronomy Club, Nov. 7, 12 noon, cafeteria conference rm., Bldg. 1. Guest speaker, Dr. H. Plotkin, optical systems branch.

Goddard Wives Club (Monthly meeting), Nov. 14, 10:30 a.m., luncheon and tour—Mellon Art Gallery. For further details call: Joan Mengel, JU 7-6146.



Wayne Traylor, seated, and Larry Cook, both of the structural dynamics branch, run a vibration test on the new automatic control console to predetermine vibration levels.

New Automatic Control Console Increases Vibration Test Capability

Goddard's capability to perform satellite vibration tests has been significantly increased as the result of arrival of a second automatic control console.

The console was specially installed to serve as the prime facility to test the S-3b satellite. The present console served as the backup facility and was available in case of emergency.

In addition to increasing the test and evaluation division's testing capability, the new console is expected to provide higher quality results from vibration tests, said Bill Forlifer, head of the vibrations section, structural dynamics branch.

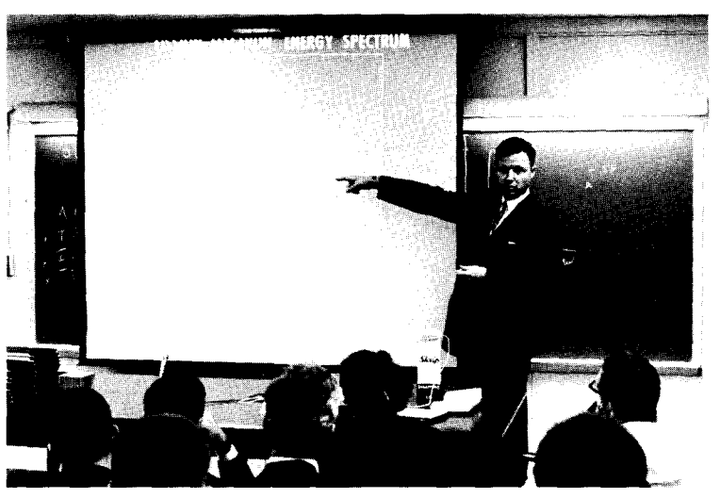
"Our present console was a developmental model—No. 1 in a series, in fact—and subsequent models have been improved."

The big benefit from the new console is in having an additional one on hand in case either needs repair. This will allow test schedules to be met more precisely, said Mr. Forlifer.

The console works like a giant hi-fi set. It controls the impact of electrical current and voltage into a 200-kilowatt amplifier. The amplifier "programs" the information and passes it on in the form of sine waves or random noise into the 10,000-pound vibrator or "shaker."

The "shaker" performs two types of vibration tests:

- Sinusoidal, which simulates rocket motor resonant burning conditions, and
- Random, which simulates the vibration generated by rocket engine noise and air turbulence during flight.



DR. WILMOT HESS, chief of the theoretical division, discusses the artificial radiation belt at the first session of the 1962-63 colloquim series at the Goddard Institute for Space Studies in New York City.

Transistor Circuit Courses Are Given

"Semi-conductor Physics" and "Local Feedback" were the subjects at the opening sessions of Goddard's third basic and second advanced transistor circuit application courses which began Oct. 2.

The courses, taught by Robert Chapdelaine of Capitol Radio Engineering Institute, are being presented as part of Goddard's continuing program of formal technical training for its technicians.

The basic course includes transistor theory and basic circuit applications of transistors, while the more sophisticated advanced course is concerned with transistor oscillators, power supplies, amplifiers and switching applications.

As a result of these courses, Goddard technicians will be better prepared to deal with more complicated problems involving transistor circuits, said Mike Patchan, assistant in the employee development branch.

Tool Cribs Help Storage Problems

What do you do when inner space becomes as much of a problem as outer space?

You use modular storage cabinets, reports Maurice Levinsohn, chief of the fabrication division.

The self-service tool cribs with shallow drawers store drills, taps, micrometers, and other tools and equipment.

The problem of storing "air" is eliminated and there is more floor space in the division for manufacturing, according to Mr. Levinsohn. The division has been able to reduce its storage space by half, he estimated.

Advantages of the cabinets include:

- Protection against bouncing for calibrated gages and delicate parts in partitioned drawers.
- Greater cleanliness from dust and dirt.
- Savings of a tool crib operator.
- Individual labeling of each drawer.
- More efficient use of available storage space.

NASA, Goddard Honor Employees for

DR. JOHN TOWNSEND, JR., receives Outstanding Leadership medal from Dr. Robert Seamans, Jr., NASA associate administrator.

DR. JOHN LINDSAY receives the Exceptional Scientific Achievement medal from Dr. Hugh Dryden, NASA deputy administrator.

Three Goddard scientists and the tracking and data systems directorate received special NASA honors for their contributions to the nation's space effort.

• Dr. John Townsend, Jr., assistant director for space science and satellite applications, received NASA's Outstanding Leadership medal for his direction of explorations of the Earth's atmosphere and ionosphere. Dr. Robert Seamans, Jr., NASA associate administrator, made the presentation.

• Dr. John Lindsay, associate chief of the space sciences division, was awarded the Exceptional Scientific Achievement medal for his achievements in the study of the Sun and Earth-Sun relationships as project manager and scientist for the Orbiting Solar Observatory, orbited on March 7.

• Robert Bourdeau, chief of the planetary ionospheres branch, received the Exceptional Scientific Achievement medal as the individual responsible for guiding all aspects of Explorer VIII, launched Nov. 3, 1960. In this project he made major scientific advances in the study of the Earth's ionosphere and the plasma sheath which surrounds spacecraft. He was also project scientist for Ariel, the US-United Kingdom satellite placed in Earth orbit on April 26. Dr. Hugh Dryden, NASA deputy administrator, presented these awards.

• Goddard's tracking and data systems directorate was awarded the Group Achievement award by James Webb, NASA administrator. It was accepted on behalf of the directorate by Ozro Covington, deputy assistant director for operations.

Departments included in the Group Achievements award consist of the deputy assistant director's office, data support office, and the following branches: procedures and evaluation, network operations, network engineering, advanced projects, operational computing, and communications.

Each individual comprising the group award will receive a 5 by 7-inch miniature of the citation.

The citations read as follows:

Dr. Townsend:

". . . for his superior and vital leadership role in working with the Manned Spacecraft Center (formerly space task group) in planning, reviewing, evaluating, and recommending actions in Project Mercury leading to the first United States manned orbital space flight."

Dr. Lindsay:

". . . for the achievement of a major scientific advance in the study of the Sun and for significant technological progress in highly precise satellite attitude control, as both project manager and scientist for the first Orbiting Solar Observatory, the most complex Earth satellite launched to date."

Mr. Bourdeau:

". . . for a major scientific advance in the study of the ionosphere and for significant technological progress in the understanding of the plasma sheath about satellites on his assignment as project manager and scientist on Explorer VIII, NASA's first satellite to investigate the ionosphere, and project scientist of Ariel."

Tracking and Data Systems:

". . . for superior technical and administrative leadership and outstanding results in the operation of the global manned spacecraft tracking network."

ROBERT BOURDEAU receives the Exceptional Scientific Achievement medal from Dr. Hugh Dryden.

GROUP ACHIEVEMENT AWARD presented by James Webb, NASA administrator, is accepted by Ozro Covington.

Leadership, Achievement and Service

Harry Johnson, Herman Gaastra, and Lavinia Tarr received 30-year pins from Dr. Harry Goett, Goddard director, at special awards ceremonies.

20-Year Service Awards

Lewis J. Allison
John T. Atkins
Jones Atkins, Jr.
Francis A. Beall
Roy C. Bennett
Raymond E. Berkeley
Joseph Berliner
Henry J. Bernstein
Robert L. Brillante
Elsie M. Brookshier
Anthony G. Brozena
James R. Burton
Edgar G. Bush
Herbert I. Butler
David L. Byer
Ciro A. Cancro
Bernard R. Cantor
Henry Carleton
Joseph R. Chisholm
Leland B. Clark, Jr.
Alach L. Cole
Reynolds W. Collins
Bernard Coski
Philip J. Crossfield
Chester B. Cunningham
Elmer B. Cutright
Charles B. Davis
Harris Davis
Russell F. DeAtley
Eva C. DeMoss
Milton F. DeNault
Curtis S. Dennis
Saverio DiBenedetto
Raymond W. Disilvestre
William E. Doles
Cecil N. Draper
William E. Dulin
James E. Duvall
Stanley D. Fawley
Aaron Fisher
Joseph F. Fitzpatrick
Anthony P. Flanick
Arthur C. Flayhart
John E. Flynn
Robert Y. Flynn
David B. Friedman
Frederick F. Frissell, Jr.
William A. Gallo, Jr.
Gertrude A. Garnett
Walter J. Gates
William H. Gibbs
John C. Graham
Gerald E. Griffin
Charles R. Hamilton
Markham W. Hanchette
Leonard Hardis
Fred X. Hartman
Richard B. Hutchison
Antonina G. Ingegneri
John E. Jackson
Dexter W. Jenkins
Sidney H. Johnson
Harry S. Jones
Robert A. Kenney, Jr.
William T. Kitts
Abe Kopan
Kasmier J. Kurek
Paul A. Lantz
Frank A Leschinsky
John E. Liner
Clifford R. Link
Donald McClenon
William G. McDermott
Richard G. McGowan
Donald E. McQuown
Frank D. Martin, Jr.
Herbert Meyerson
George Mikalaski
Joseph V. Natrella
George W. Newton
William H. O'Hara
John A. O'Keefe
John C. Onda
Harry T. O'Toole
Gerald B. Pate
Lewis E. Paul
Harold J. Peake
Elmer H. Pessagno
Christine G. Phillips
Clarence E. Pickett
Joseph G. Pometto
Harry Press
Joseph F. Proff
Joseph D. Robinson
Edward L. Rosette
Casper S. Salisbury
Harold Shapiro
Joseph M. Sherfey
Larry R. Shinnick
Clifford W. Shorter
Joseph W. Siry
Charles P. Smith, Jr.
Walter V. Smith
Julius C. Sohn
George F. Somerville
Ernest F. Sorgnit
Giles H. Spaid
Otto T. Steiner
George E. Stine
Roy E. Stockes
William M. Stone, Sr.
James P. Strong, Jr.
J. Frederick Taub
Frederick G. Thorne
Wayne M. Traylor
Ronda Triplett
William M. Tucker
Wade C. Turney
John V. Viynos
William A. White
Charles E. Whitfield
Charles P. Wood
Philip Yaffee
Howard F. Zabriskie
William Ziegler

One-hundred-thirty Goddard employees received 20- and 30-year honorary service emblems from Dr. Harry Goett, Goddard director, at the 4th Service Emblem Award ceremonies in the auditorium of building 3.

Five awards for 30 years' service were presented for the first time at Goddard. Recipients were Armin Apelt, electrical engineer, spacecraft technology; Bertram Clendinnen, electronic technician, space sciences division; Herman Gaastra, engineering designer, test and evaluation division; Harry Johnson, heating, refrigeration and diesel plant operations leader, facilities engineering division, and Lavinia Tarr, time, leave and payroll clerk, financial management division.

One-hundred-twenty-five employees received pins for 20 years' service, Ten- and fifteen-year awards will be presented in separate ceremonies arranged by assistant directors and the chief of the technical services.

The honorary service emblem is a replica of the NASA insignia and is awarded to employees in recognition and appreciation of faithful service to the NASA and the United States.

The United States Air Force combo "The Top Hats" supplied the music for the occasion. William Ritter, chairman of the incentive awards committee introduced Dr. Goett. Dr. Goett praised Goddard employees for their contributions toward the progress and accomplishments of the Center since it opened.

Thirty-year pin recipients are Bertram Clendinnen and Armin Apelt.

At right is William Ritter, chairman of incentive awards committee.

Goddard to Investigate Maser Techniques

Investigations into a relatively new area of radio electronics has been undertaken by the RF systems branch.

The program has brought into the laboratory of the low noise techniques section a host of instrumentation that would seem more at home in a physics laboratory. This includes a 5400-pound electro-magnet, two extremely sophisticated vacuum pumps, several thermal flasks of liquid nitrogen and liquid helium, an unpolished, rectangular man-made ruby and a stainless steel vessel called a "dewar," or dawar flask.

Primary Tool

When completely assembled and put into operation by C. Curtis Johnson, head of the section, this array of impressive hardware will become the primary tool in the new program—a solid-state MASER (Microwave Amplification by Simulated Emission of Radiation).

It is certain that the maser will be quite useful in future Goddard tracking and data acquisition systems, as a radio frequency pre-amplifier between the antenna and the receiving equipment. It is this pre-amplifier which can determine, by the amount of radio frequency noise it generates, the maximum sensitivity of the entire system.

Program Objectives

"We are setting up a system here at Goddard for the investigation of maser techniques, which at this time represents the ultimate in low-noise radio frequency amplification," Mr. Johnson said. He then went on to itemize the major objectives of the program. They are:

- Reduction of size and weight of present maser systems.
- Investigation of self-sustaining, closed-cycle cryogenic systems. Such systems would trap and reclaim vaporizing coolants now allowed to escape.
- Improvement of maser reliability.

Basic Principles

The properties and interactions relevant to the maser can be summed up under two headings.

- Atomic and molecular particles tend to exist naturally at discrete energy levels.
- They can jump from one energy level to another under the influence of an electromagnetic wave of the right frequency. In the process they give up to the wave, or absorb from it, a discrete quantum of energy, depending on whether they dropped to a lower level or were lifted up.

C. CURTIS JOHNSON, head of the low noise techniques section, and Tom McGunigal, aero-space electronic engineer, discuss the orientation of the MASER ruby inside the "dewar."

The last statement contains the germ of the maser principle.

For continuous maser amplification, three of these discrete energy states are utilized. The difference between the lowest energy state and the highest corresponds to energy absorbed by the particles from a microwave "pump". The energy between the highest and the intermediate states corresponds to the energy given up by the particles to augment the microwave signal being amplified. Since the frequency of the "pump" is different from the signal frequency, the maser can operate continuously.

The present maser systems must operate at extremely low temperatures (4.2° K or —452° F). Mr. Johnson pointed out that investigation of new materials to replace the maser ruby might make operation at higher temperatures possible.

"This could permit simplication of the present cryogenic systems, bringing immediate reductions in both size and weight. It also would make a closed-cycle cryogenic system more practical," said Mr. Johnson. "Our problem is essentially that of adapting a proven laboratory system to our specific operational requirements."

Sky Noise Out

Sky noise from such sources as radiating stars is actually greater at presently used frequencies than the noise generated by pre-amplifiers now in use. Therefore, pre-amplifier noise is not a problem in our present systems. One benefit of the higher frequencies being considered for future use will be the near absence of sky noise. Under these new conditions, the noise generated by the pre-amplifier will represent the remaining noise problem, and it will place an undesired limit on system sensitivity. At this point the maser amplifier may be used to significantly enhance low signal level capabilities because it generates an insignificantly small portion of a system's total noise.

Near Absolute Zero

A synthetic ruby is the material in which the atomic amplification takes place, thus, the name "solid state" maser. The ruby is placed inside the dewar, which is then suspended in the field of the electro-magnet. The dewar is a cryogenic cylinder, roughly similar to a large thermos bottle, consisting of four concentric tubes and necessary radio frequency input and output connections.

The area between the outer and second tube is evacuated to a pressure of 10^{-9} mm of mercury to provide optimum thermal insulation of the inner chambers. Liquid nitrogen fills the area between the second and third tube and provides buffer cooling to 78° K (—319° F). Liquid helium fills the area between the third and inner walls, placing the temperature of the center chamber, containing the ruby, at 4.2°K (—452°F). By reducing the pressure in the helium chamber, temperatures down to 1.8° K are attainable.

High Intensity Field

The 5400-pound electromagnet produces a high intensity DC magnetic field up to 10,000 gauss across a three-inch gap between its poles. This intensity requires that the 40,000 turns of wire on the magnet carry a current of 2 amps. Normal operation of the present maser system, however, requires only about a 2,000 gauss field.

The function of the magnetic field in maser operations is to provide the energy levels of the ions. This affects the transition frequency, making the operating frequency of the maser a function of the field intensity. Thus, the maser can be readily tuned without any internal adjustments.

Mr. Johnson, working under the direction of Victor Simas, head of the branch, is completely at home amid the plastic tubes and RF waveguide equipment which link the various parts of the maser.

Canada's Topside Sounder Provides New Data on Arctic Ionosphere

John Jackson, Goddard project manager for the Canadian-built Alouette Topside Sounder, spoke on first results of the satellite to the Goddard colloquium lecture. Highlights of the talk are presented in the following questions and answers.

John Jackson

What new knowledge about the ionosphere can we expect from the topside sounder satellite?

The bulk of the data will be along the 75th meridian and will extend in latitude from 80 degrees North to about 65 degrees South, i.e., North and South American continents.

We need information about the ionospheric structures in the polar and equatorial regions, where it is far more complex. The arctic ionosphere is, of course, the main interest of Canada.

Why is the ionosphere more complicated at high and low latitudes?

The ionosphere is created and principally controlled by solar illumination, which varies considerably between winter and summer in the arctic. One of the mysteries of the polar ionosphere is the fact that ionization persists during the winter months when no sunlight is present. In addition, the ionosphere in the auroral zones is very severely disturbed by the flux of energetic particles which causes the auroras.

The equator also exhibits anomalies which are attributed to the fact that the terrestrial magnetic field is nearly horizontal and that electrical currents (the electro-jet) are concentrated in the equatorial ionosphere.

What is the practical significance to radio communications of a disturbed ionosphere?

Depending upon the severity of the situation, this can render radio communications anywhere from difficult to impossible.

Will not Telstar and other communications satellites by-pass this difficulty?

Yes, they will for countries which can afford them. However, many nations and private enterprises will continue to depend upon ionospheric communications. This is analogous to saying that great advances in transportation, e.g., jet planes, have not and will never replace automobiles, bicycles and even human legs.

Do the preliminary results indicate that the topside sounder satellite will meet its objectives?

Yes, in fact the satellite results are even better than what had been hoped for. First, the orbit and the satellite orientation are nearly perfect for the intended mission; second, this instrumentation is working perfectly; and third, the information obtained is more complete than we had expected.

What is the nature of this increased information?

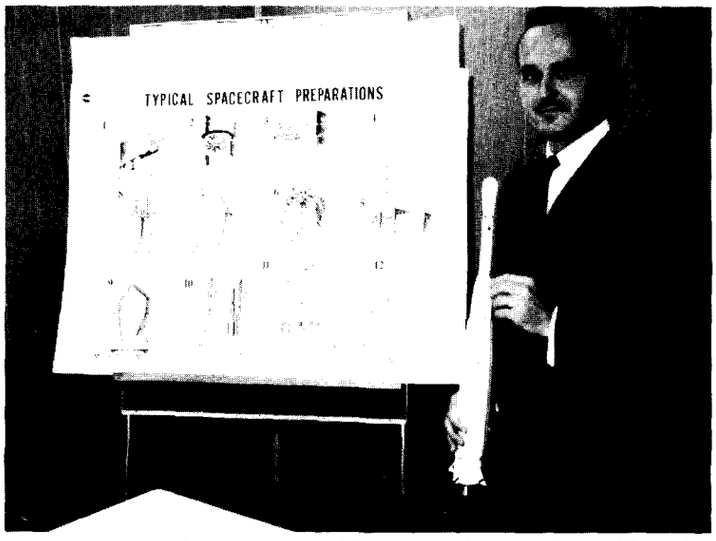
It was planned to obtain the ionospheric electron density profiles from topside echoes received by the sounder. It turns out that the sounder is also providing very accurate measurements of ambient conditions around the satellite as a result of so-called "splash" phenomena. The splash phenomena are interactions between the sounder and its immediate surroundings which occur at several specific sounder frequencies corresponding to the local plasma frequencies, to the local gyro-frequency, to several other algebraic combinations of these frequencies, and at frequencies corresponding to harmonics of the fundamental splash frequencies.

What is the significance of these effects?

These effects should enable us to determine the local electron density and the local magnetic field intensity with an accuracy of the order of 1 per cent. This was an unexpected bonus from the sounder experiment. The splashes at harmonic frequencies give a strong indication that a local phenomenon similar to parametric amplification is taking place in the vicinity of the satellite. It appears that these phenomena could be the basis for new techniques of direct measurements.

Will the sounder techniques be useful for planetary explorations?

The sounder can provide information from the outer atmosphere of planets all the way to their surface. In fact with the present sounder we are frequently getting returns from the ground which show that the sounder is also a fairly accurate altimeter. These capabilities, which would be very useful in planetary fly-by experiments, are being considered for planetary missions.



BOB GRAY, chief of the field projects branch for AMR and PMR, talked to a recent meeting of the Canaveral Group of the American Society of Mechanical Engineers. Mr. Gray spoke on "DELTA-NASA's Most Reliable Space Research Vehicle." According to Ray Norman, Jr., also of the field projects branch, the members asked questions for two hours following the talk. Mr. Norman recently was elected chairman of the Canaveral Group.

Goddard Speech and Paper Presentations

(Technical presentations approved as of Oct. 30 for period of Nov. 5-18)

MEETINGS

H. Oseroff, **aeronomy and meteorology div. Joint Meeting Institute of Navigation, American Congress of Surveying and Mapping, and American Society of Photogrammetry, Nov. 6, St. Louis.**
"Photographic, Photogrammetry and Cartographic Aspects of the Tiros Meteorological Satellite System."

Dr. Su-Shu Huang, **space sciences div., (presentation by *Dr. R. H. Wilson*, NASA hqs.) 17th Annual Meeting and Space Flight Exposition, American Rocket Society, Nov. 13-18, Los Angeles. "Periodic Orbits for Moon Probes."**

H. E. Evans, **spacecraft technology div., 17th Annual Meeting and Space Flight Exposition, American Rocket Society, Nov. 13-18, Los Angeles.**
"Mechanical Elements for Vacuum Operations."

SPEECHES

T. S. Johnson, **optical systems br., Ohio State Univ. Symposium on Laser and Applications, Nov. 7-8, Columbus. "A Laser Satellite Tracking Experiment."**

M. Levinsohn, **chief, fabrication div. Ordnance Mobilization Detachment No. 28, Nov. 8, Wash., D. C. "General Discussion of NASA's Space Program and Fabrication Problems Associated with Space."**

Dr. W. Hess, **chief, theoretical div. University of Md., Institute for Fluid Dynamics and Applied Mathematics, Nov. 13, 20, 27, 4 p.m., Rm. Y-315, Math Bldg. "The Radiation Belts of the Earth." (A Series of three seminars discussing the structure of the electron and proton radiation belts trapped in the geomagnetic field.)**

Atmospheric and Plasma Physics Seminars are Given at Institute

Two series of seminars are being given during the current academic year at the Goddard Institute for Space Studies in New York City.

Seminars on atmospheric physics are conducted on alternate Tuesdays by Dr. Robert Jastrow, director of the Institute, and Prof. Edward Spiegel, New York university.

A series of seminars on geophysical and astrophysical applications of plasma physics is under the direction of Prof. H. Y. Chiu, senior research associate at the Institute, and Dr. C. S. Shen, research associate. The meetings are held on alternate Thursdays.

Among the topics to be discussed at the meetings on atmospheric physics are radiative transfer in non-gray atmospheres, convective transport, planetary circulation, anisotropic scattering and polarization effects, and the structure of the upper atmosphere.

Subjects at the seminars on geophysical and astrophysical applications of plasma physics include orbit theory, the Boltzmann equation, macro- and semi-macro equation, the energy principle, stability criteria, confinement of plasmas, hydromagnetic theory, thermonuclear devices, radiation belts and aurorae, the interplanetary gas, solar physics, magnetic stars and interstellar gas dynamics.

Lecturers in the series include Profs. Edward Frieman, Martin David Kruskal, Lyman Spitzer and John Dawson of Princeton university, and Prof. Harold Grad of New York university.

A colloquium on topics of general interest on space physics meets at 4 p.m. each Thursday.

(Continued from page 1)

"If NASA disseminates new knowledge resulting from its space program in the form of ideas and innovations to American industry, hopefully, industrialists will translate them into new products, processes, techniques, devices and material for the benefit of the national community."

Program Underway

Implementation of the program already is progressing at Goddard. For example, eighty innovations or suggestions have been submitted to Mr. Keller, of which 43 have been forwarded to NASA headquarters.

Ideas are carefully checked to screen those of a proprietary nature, i.e., belonging to a contractor; those of improper subject matter or those having potential value as an invention where commerical rights might be owned by a government employee.

The program does not involve just a one-way flow of information, said Mr. Keller, for Goddard will benefit in learning of techniques used by contractors and other NASA centers.

A typical idea was recently received from the Langley Research Center for possible use here. It involves conversion of a Speidel playback tape recorder to provide longer time delays of 1 to 2 minutes required by NASA. Original time delays of the recorder were designed for 10 seconds.

New Ideas

An attempt is being made to devise techniques for the reporting of ideas that will impose a minimum workload on the technical staff.

"In order for Goddard to fully participate in the program, each staff member will need to be on the lookout for useful technology and call it to the attention of the applications office."

(Continued from page 1)

head, astrophysics branch, discussed space atronomy opening new windows to the universe in the ultraviolet, X-ray, and gamma ray spectral regions.

Aeronomy Research With Rockets and Satellites

Nelson Spencer, head, physics branch, discussed the advancing technology which permits direct scientific measurements in outer space, citing examples of results from past space research projects. He explored the future plans now in the offing.

During the "Data Acquisition and Processing" session, John Mengel, assistant director, tracking and data systems was chairman.

Data Processing for Orbit Determination

Dr. Joseph Siry, chief, theory and analysis staff, discussed orbit determination from both the theoretical and the analytical points of view. Dr. Siry pointed out that there are several types of tracking data which can be used in satellite orbit determination and that none of them is foolproof if insufficient data exists.

Data Acquisition and Processing From Scientific Satellites

Albert Ferris, chief, space data control branch said, the principal objective of scientific satellite missions is the extraction of data of all types. The volume of data obtained is very large and the variety is limited only by the ingenuity and inventiveness of the experimenters.

Data Processing from Meteorological Satellites

William Bandeen, aeronomy and meteorology division, discussed satellite design as well as the information flow from the orbiting sensors to the final output for use on the ground—of television cloud cover pictures, along with infrared and reflected colar radiation data received by Tiros.

Mr. Bandeen said the six Tiros satellites paved the way for processing the data from the second generation Nimbus meteorological satellites.

In the special session on "Celestial Mechanics and Space Flight Analysis," William Kaula, theoretical division, disclosed that models of the upper atmosphere have had to be changed constantly since the first satellite was launched in 1957, as a result of the atmospheric drag observed during various satellites' flights.

Chairman for the sounding rocket session was Dr. Harry J. Goett, director. Miss Eleanor Pressly, head, vehicle section, sounding rockets branch said, the sounding rocket is still a most valuable vehicle in the space scientist's hangar. Sounding rockets are most useful for training new groups entering space research and in testing experiments for future flights on satellites, to make sure that the experimental data will be on scale and meaningful, Miss Pressly explained.

15,000 Visit Wallops Station

A "drive-by, do-it-yourself" tour attracted 15,000 visitors to Wallops Island during a two-day open house.

Over 3,000 cars averaging five or more persons per car streamed across the two-mile causeway leading to the Island. There were 2,501 vehicles on Sunday and 545 on Saturday.

Included among the Saturday visitors were approximately 400 eastern shore Boy Scouts and their leaders who came to Wallops Station for a program and demonstration in observance of fire prevention week.

FIRST ARRIVAL for Wallops Island open house is welcomed by Robert Krieger, right, director of Wallops station. Mr. and Mrs. Charles Smeltzer of York, Pa. were the first visitors to arrive at the Causeway gate.