# GODDARD NEWS

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## Need Grows for Data Interpreters

According to Dr. Harry J. Goett, Goddard director, scientific satellites now produce magnetic tape data at a rate of 140 miles per day, creating an urgent need for qualified scientists to assimilate and interpret this continuous flow of spaceborne information.

Addressing evaluation panels for National Science Foundation fellowship programs, Dr. Goett told some 200 scientists, from various U. S. universities the need for competent personnel to interpret the data now being sent back from outer space.

According to Dr. Goett, Goddard tracking stations are currently receiving data from some 15 scientific satellites producing 140 miles of magnetic tape per day. "If this data is to be properly analyzed and assimilated, it is going to take qualified people to do this job," he said.

"While pre-launch and launch activities produce considerable public attention, the really exciting story of space exploration comes when the many facets and pieces are put together and a pattern begins to emerge."

This job is not only being done at Goddard, but throughout the U.S., and not only at Government laboratories but also at many universities both here and abroad.

"This large scale cooperative effort is really the accomplishment of the space age," he said.

During the course of his presentation Dr. Goett discussed Goddard's scientific satellite program carrying 90 scientific experiments.

He spoke at the National Academy of Sciences. The audience was composed of scientists evaluating applications for N.S.F. Cooperative Graduate Fellowships, N.S.F. Summer Fellowships for Graduate Teaching Assistants and N.S.F. Graduate Fellowships.

To date, approximately 50 post-doctoral scientists under the NAS-NRC research associateship program have worked at Goddard and the Institute for Space Studies in New York.

# Communications Satellites in the News

*Italian Premier Fanfani's recent visit to the U. S. was photographed and the pictures of his Chicago stopover were transmitted by RIA from Chicago to Europe through the Relay communications satellite and the wideband communications station. This print is from a 3 by 4-inch Polaroid camera snap of the television monitor at the Nutley, N. J., station.*

*This is a photo facsimile print of the unveiling of the Mona Lisa at the Washington Gallery of Art. The photograph was transmitted by Agencie France Presse from their Washington office via Relay To Europe. Left to right are President Kennedy, Mme. Andre Malraux, French Minister of Cultural Affairs Andre Malraux, Mrs. Kennedy, and Vice President Johnson.*

After a successful launch—No. 15 in a row for the Delta vehicle—the world's first attempted synchronous satellite—Syncom—is eluding its worldwide trackers.

Launched just after midnight a week ago Thursday, contact with Syncom was lost minutes before the complicated feat of achieving the synchronous orbit appeared near. The spacecraft was to have achieved an orbit 22,300 miles above the earth where it would hover along a line of longitude by traveling at the same speed as that of the earth's rotation.

During the 5 hours "coast" period after separation from the Delta, all systems appeared normal in the spacecraft, according to Alton Jones, project manager. Command, telemetry, range and range rate, and communications systems checked out normally, he said.

A routine decision was made to fire the apogee motor some 10 minutes before it would automatically be fired by a timer in the spacecraft. The signal was sent from the USNS Kingsport, anchored in the harbor at Lagos, Nigeria, and was received in the spacecraft.

About 20 seconds later the telemetry signal was lost at all stations, and no contact has been established since. The search is continuing by the Satellite, Deep Space, and Smithsonian Astrophysical Observatory networks.

Initial speculation on the cause of the malfunction after the apogee motor "fire" command was executed concerned the possibilities of propulsion failure in the motor or loss of electrical power, according to Mr. Jones. Analysis of telemetry data obtained during the early contacts is underway at the present time to arrive at a more conclusive determination, he said.

Syncom weighs 86 pounds and was to have moved in an elongated figure 8 pattern north and south of the equator. It was to have been capable of transmitting a 2-way telephone or several teletype messages. It would have linked the U. S. and Africa for the first time.

## *Schindler Gets National Capital Award*

Bill Schindler, technical director of the Delta launch vehicle program, was one of 21 engineers and applied scientists from industry and government in Greater Washington to receive a National Capital Award at the annual Engineers, Scientists and Architects Day awards luncheon Wednesday. The luncheon was held at the Presidential Arms.

**Schindler**

The National Capital Area honors the men and professions of engineering, science and architecture each year on ES&A day, which is sponsored by the D. C. Council of Engineering and Architectural Societies and the Washington Academy of Sciences.

Roll D. Ginter, program chief in the office of space sciences at NASA headquaters, also received an award.

In addition to the National Capital Awards, 12 outstanding science and mathematics teachers were honored with Distinguished Service Awards in recognition of their inspiration to young students to select engineering and science as their career choices.

Dr. S. Fred Singer, director of the National Weather Satellite Center, U. S. Weather Bureau, spoke on "A Satellite Looks at the Weather". A morning panel on "Economic Applications of Earth Satellites" was lead by Dr. Morris Tepper, director of meteorogical systems at NASA headquarters.

*ENJOYING a laugh at the laser symposium dinner are Dr. Harry Goett, Goddard director; Dr. Raymond Bisplinghoff, director of the office of advanced research and technology, NASA headquarters; Dr. Charles Townes, Massachusetts Institute of Technology, the dinner speaker; Dr. Albert Kelley, director of electronics and control, office of advanced research and technology, NASA headquarters; and John Mengel, assistant director for tracking and data systems.*

# 100 At Goddard Conference Hear Dr. Townes Review Laser Advances

Some 100 representatives of NASA's field centers and installations attended Goddard's first intra-agency technical conference on optical communications and tracking Feb. 5-6.

Purpose of the conference was to provide for an exchange of technical information on laser optical and tracking programs at each of the centers.

"We have a better idea now of how we can work more closely," said Walter Carrion, associate head of the optical systems branch, in the absence of Dr. Henry Plotkin, branch head and co-chairman of the conference. "I am sure everyone is more aware of various research and development activities and programs underway throughout NASA."

**Plotkin**

The program was divided into four classes of papers, consisting of facilities and programs, basic science and engineering, technological developments and systems.

Dr. Charles Townes of the Massachusetts Institute of Technology was the featured speaker at the evening dinner the first day.

The human mind and ingenuity will find solutions to almost every conceivable scientific or technical problem, Dr. Townes told his audience.

Only if such advancements are unimportant or contrary to some basic law of nature will there be limitations in development, he said.

Using the laser and optical maser as examples, Dr. Townes said that the first maser was considered a "fairly wild idea" when it was first started just 12 years ago.

He described the progess made in the dozen years since then in developing the devices to their present levels.

Dr. Townes related an amusing rule of thumb he called the pi-law—that performance of any device or system will be pushed to within a "factor of pi of the limit of performance set by fundamental laws, assuming this performance is of sufficient importance."

This applies, for exmple, to the efficiency of lasers and optical masers, which began with efficiencies in the order of a 10th of a percent or less, he said.

Explaining that many people were pessimistic and thought the devices were inefficient, Dr. Townes said masers now have "efficiencies clearly better than 50 per cent and have fallen within the pi law."

He said that optimum efficiency is likely to suffer if optimum power output were desired as well, and that both high efficiency and high directivity can be expected to be degraded if the emphasis were placed on both. This might be called the "pi-to-the-nth-power-law, were n is the number of parameters to be optimized," he said.

Dr. Townes attributed the support of fundamental research as an important contribution to the development of masers and to many important applied discoveries of the future. He said he never considered the development of optical masers to be anything but difficult, because if the process were simple it "surely would have been discovered accidentally long, long ago."

The pioneer in the maser and laser fields said that while the laser beams afford exceedingly high directivity, other components of the system will be taxed to the limit to achieve this precision. He said that so far as total power is concerned, almost any amount is possible assuming it is sufficiently important to achieve such an output.

Looking to the future Dr. Townes said that optical masers will be developed both for a wide variety of applied uses, and "in such ways that will lend themselves to fascinating further scientific exploration."

# Space Investment Well Worth Cost, Dr. von Braun Tells Institute Seminar

Benefits from America's space program will far outweight the cost, Dr. Wernher von Braun, director of the Marshall Space Flight Center, told scientists at a special seminar at Goddard's Institute for Space Studies in New York Feb. 6.

The revenues from communications satellites alone will, by 1975, exceed the cost of NASA's program in the area said Dr. von Braun.

He said there will also be benefits on which no price tag can be placed, such as discovery of the Van Allen radiation belts and the accomplishments of the weather satellites.

At the same time, Dr. von Braun said that man himself is a very important link in space exploration, and that the value of placing a man on the moon cannot be debated.

"Instrumented equipment can do the job if one knows exactly what he is seeking," he said. "However, if one doesn't know, then automated equipment is not quite good enough."

Dr. von Braun said that a trained geologist on the surface of the moon could detect more in five minutes than an astronaut would see in 25 years.

Using slides, Dr. von Braun described the development of the giant Saturn rocket at Huntsville, and explained in detail the lunar orbit rendezvous technique which will be used for a manned lunar landing. In response to questions from the audience, he discussed the relative merits of this technique and that of earth orbit rendezvous.

Dr. von Braun was introduced by Dr. Robert Jastrow, director of the Institute.

*DR. JACQUES BARZUN, left, dean of faculties and provost of Columbia University, chats with Dr. Robert Jastrow, center, director of the Institute, and Dr. Wernher von Braun, director of the Marshall Space Flight Center, after the latter's talk at the Institute.*

*VISITING the Institute the same day as Dr. von Braun was NASA Administrator James Webb, left, who was in New York to address a meeting of the American Bankers Association and to meet with Columbia University President Grayson Kirk. Here he talks with Dr. Kevin Prendergast, senior research associate at the Institute, about the latter's work on galactic evolution.*

## *Field Branch Expands To Serve Agena and Centaur Missions*

Expansion of Goddard's field projects branch at the Atlantic and Pacific missile ranges is underway as the result of assignment of the launch responsibility for NASA's Agena and Centaur vehicle programs.

Total field personnel will increase from the present 36 to about 100 to meet the new responsibilities, according to Daniel Mazur, head of the spacecraft systems and projects division.

He said that the establishment of three project offices is being planned to handle the two new vehicle projects plus the present Delta program. The three offices, under branch head Bob Gray, would be organized on project and functional bases. This would have personnel identified with specific vehicle projects attached to project offices, with personnel assigned on a functional basis serving across the board in engineering services, mission support, range coordination and documentation.

### 15 Successes

The branch has been responsible for the launchings of the highly successful Delta. This has included evaluating all vehicle and payload preparations, tests, and procedures prior to passing on the flight readiness of airborne and ground systems associated with the vehicle. The Delta has provided the successful boost for 15 missions in a row, including Tiros, Telstar, Relay and OSO.

Transfer of the launch direction of Agena and Centaur to the field projects branch from the launch operations center at Cape Canaveral permits the LOC to concentrate its efforts on manned space flights, including the Saturn, and preparation of the launch site for the Saturn V Apollo moon booster. Previously overall responsibility for the Agena-Centaur programs was transferred from Marshall to Lewis. Overall program management of the two projects is directed by Dr. Homer Newell, director of NASA's office of space sciences.

**Goddard News**

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# *Skill of Artisan Finds New Place in Space Age*

In the 1500s, Benvenuto Cellini became one of the most distinguished goldsmiths of the Italian Renaissance.

Famous as a sculptor, engraver and writer Cellini was acclaimed as one of the great metalworkers of his time. The famous bronze figure, "Nymph of Fontainebleau," now in the Louvre, was made on his second trip to France.

Today, the ancient art of metal forming is making a comeback—revived by the demands and needs of a new frontier in science, the age of space.

Emphasis on the new skill of the artisan as practised by Cellini and his colleagues is finding new expression in an old tool—the Yoder hammer.

The hammer served mankind for years as a major item in shaping metal for airplanes, warships and automobiles, but did not survive the deep inroads of mass production.

### Revived at Goddard

Now added to Goddard's sheet metal branch facilities, the hammer is serving a useful purpose in shaping metals for Goddard space projects which require only one or two models for experimental and test purposes.

"We are experiencing considerable savings by not having to buy expensive stretch presses and solid dies to stamp out metal shapes," said Harry Bickford, chief of the sheet metal branch. "All that we need is a simple wooden check fixture to verify the curvature of the metal after it has been formed to the desired shape."

A unique feature of a Yoder hammer is the almost complete dependence on the skill of the operator in shaping the metals.

"The eye is the all important thing in stretching metal to desired contours," said Charles Bayle, aviation metal smith, who is Goddard's new Yoder operator.

Mr. Bayle came to Goddard in July when plans were being made to add the hammer to the fabrication division's capabilities. He previously spent 21 years at Baltimore's Martin-Marietta company as a Yoder operator.

### Rewarding Work

Mr. Bayle finds his new environment and work pleasant and rewarding, but not a great deal different because the operation of the Yoder hammer is still an "ancient" art.

One difference in the operation has evolved gradually because of the change from steel to aluminum in many industries.

When the hammer was used on auto bodies, steel was the principal metal. "Steel stayed in place, stretched easier and could be smoothed out faster," said Mr. Bayle.

When the air and space age were born, aluminum became the main metal. "Tolerances are much closer in aircraft and spacecraft and greater precision on the part of the operator is needed. There is a spring-back in aluminum which makes it harder to work."

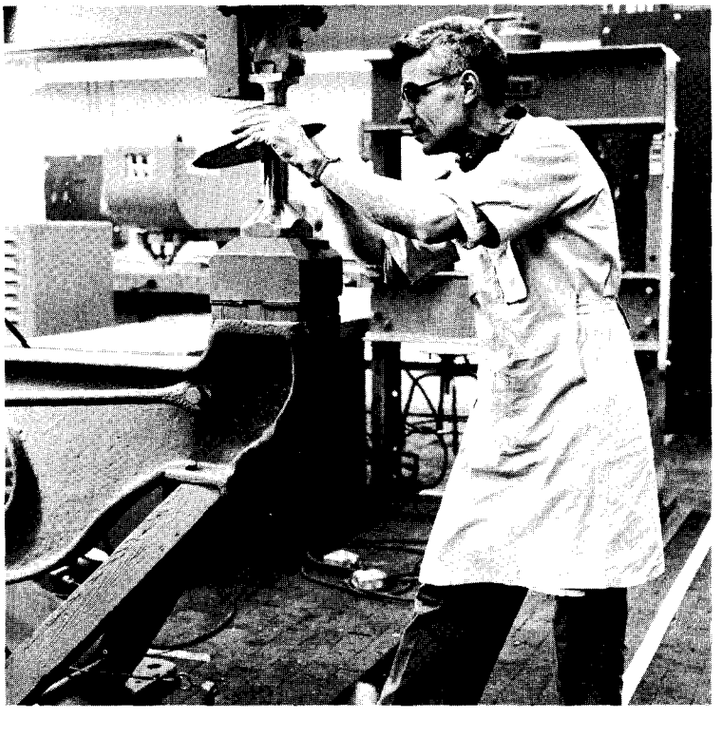
The special need for heat-resistant metals makes the Yoder hammer especially applicable to the space program, in which air dynamics is so important.

In forming deep curvatures on the Yoder hammer, the operator preforms the metal by using a sand bag and a hard rubber or wooden hammer, much in the same manner coppersmiths of old formed copper sheets to the hulls of wooden sailing ships.

After preforming it on the sand bag, the Yoder operator places the metal in the hammer and finishes forming it to the desired shape.

On less severe curvatures, he is able to stretch and form flat material to the desired shape with the aid of the hammer.

***OPERATING** the Yoder hammer, Charles Bayle forms a hemisphere from a flat piece of aluminum stock.*



# Scientific Satellite Symposium Set

Recent results from Goddard scientific satellites will be the subject of a three-day symposium March 13-15 in the Department of Interior auditorium.

An estimated 600 scientists representing the national and international scientific communities will attend.

Purpose of the symposium is to present at a single meeting the preliminary results of related experiments from the Alouette, Ariel, OSO, and Explorer XII, XIV, and XV scientific satellites orbited by the United States during the past year.

The program has been arranged in accordance with the specific satellite projects, with the experiments in each to be presented as an integral group. The session chairman will be the spacecraft project scientist.

For information regarding arrangements and reservations, phone the public affairs office, extension 5006.

Major topics to be presented and the speakers are listed on the insert in this edition.

# Goddard Seeks 200 Volunteers For Civil Defense

An estimated 200 volunteers to be trained in first aid, fire fighting, light rescue and radiological monitoring are being sought by Goddard's civil defense program.

The appeal is one of several steps being taken or planned by Robert von Roeder, civil defense planning officer, in shaping a comprehensive program of emergency action to protect lives and property in the event of fire, earthquake, explosion, enemy attack or other national emergency.

"The wide variety of skills and backgrounds possessed by Goddard personnel should provide us with an excellent nucleus of trained people for our program," said Mr. von Roeder.

The volunteers will be formed into 5 or 6-man teams consisting of team leaders, alternate team leaders and alternate members. They will be assigned to specific geographical areas of the Center and off Center Goddard locations.

### March Start Set

Initial plans of James Reese, assistant civil defense warden for training, calls for basic first aid training to start in March. The training will be given to members of first aid, fire fighting and light rescue teams, to 80 shelter managers and shelter team leaders and to 10 percent of the remaining Goddard population. Basic first aid as well as advanced first aid training will be provided by 22 graduates of Goddard's Red Cross first aid instructor's course which was recently completed (Goddard News, Jan. 14)

Radiological training has already been started under the direction of Charles Hamilton, assistant warden for radiological defense. The full requirement for radiological monitoring teams will be drawn from the present volunteer recruitment drive.

The civil defense program is organized under Eugene Wasielewski, chief warden; Leopold Winkler, deputy warden; Robert von Roeder, planning officer; and assistant wardens for first aid, Fred Hartman; light rescue, Eugene Reading; training, Jim Reese; evaluation, Ron Surgen; utilities control, Arthur Haszard, and radiological defense, Charles Hamilton.

# *New Distance, Radial Velocity System To Enhance Tracking Coverage*

A vital part of all scientific satellite data is the satellite velocity and the location in space at which various experimentation measurements are made.

This information, translated into a description of a satellite's orbit, is used in experiment analyses, scheduling ground station operations, aiming directional ground antennas, and orbitological analyses, i.e., the study of satellite orbits and orbit changes.

Satellite positional, or "tracking", data is now being supplied primarily by Goddard's world-wide Satellite network (formerly called the Minitrack network), consisting of a complex of stations extending from northern Alaska to Santiago, Chile, Johannesburg, South Africa, and Woomera, Australia (Goddard News, Feb. 11). Time-indexed data from these stations arrives at Goddard's computer facility in building 3 where it is correlated to derive the complete orbit information and to predict future orbital paths.

To define an orbit and pinpoint a satellite's location at a particular time, satellite distance and angular direction from a tracking station must be known. The present Satellite Network data provides only precise angular measurements. When a series of these measurements is digested by the computer, along with the exact times the measurements were made, all other orbit details can be derived, including satellite distance and velocity.

### Measures Distance, Radial Velocity

However, angular data by itself is not adequate for highly elliptical orbits. To enhance tracking network coverage and provide adequate high-altitude tracking measurements, a new system has been devised to actually measure satellite distance (range) and radial velocity (range rate) over nearly 180 degrees of a satellite pass, from horizon to horizon.

"This will provide us with better orbits, significantly faster than is now possible," said project manager George Kronmiller, Jr., of the systems development branch.

The new system, now being developed by the systems development branch, is a sidetone ranging system, and will supply range resolution of $\pm 15$ meters and range rate resolution of 1/10 meter per second. These figures can be achieved using the S-band portion of the system. S-band refers to that portion of the frequency spectrum between 1,550 and 5,200 megacycles.

***FIRST use of Goddard's range and range rate system is the subject of discussion by George Kronmiller, Jr., project manager; Bob Joy, OGO ground systems manager in the space projects integration office; and Paul Wren, electronics engineer in the systems design section. They are looking at a prototype of the transponder and antenna which will fly on the orbiting geophysical observatory (EGO).***

## Goddard Coming Events

**Goddard colloquium lectures:**

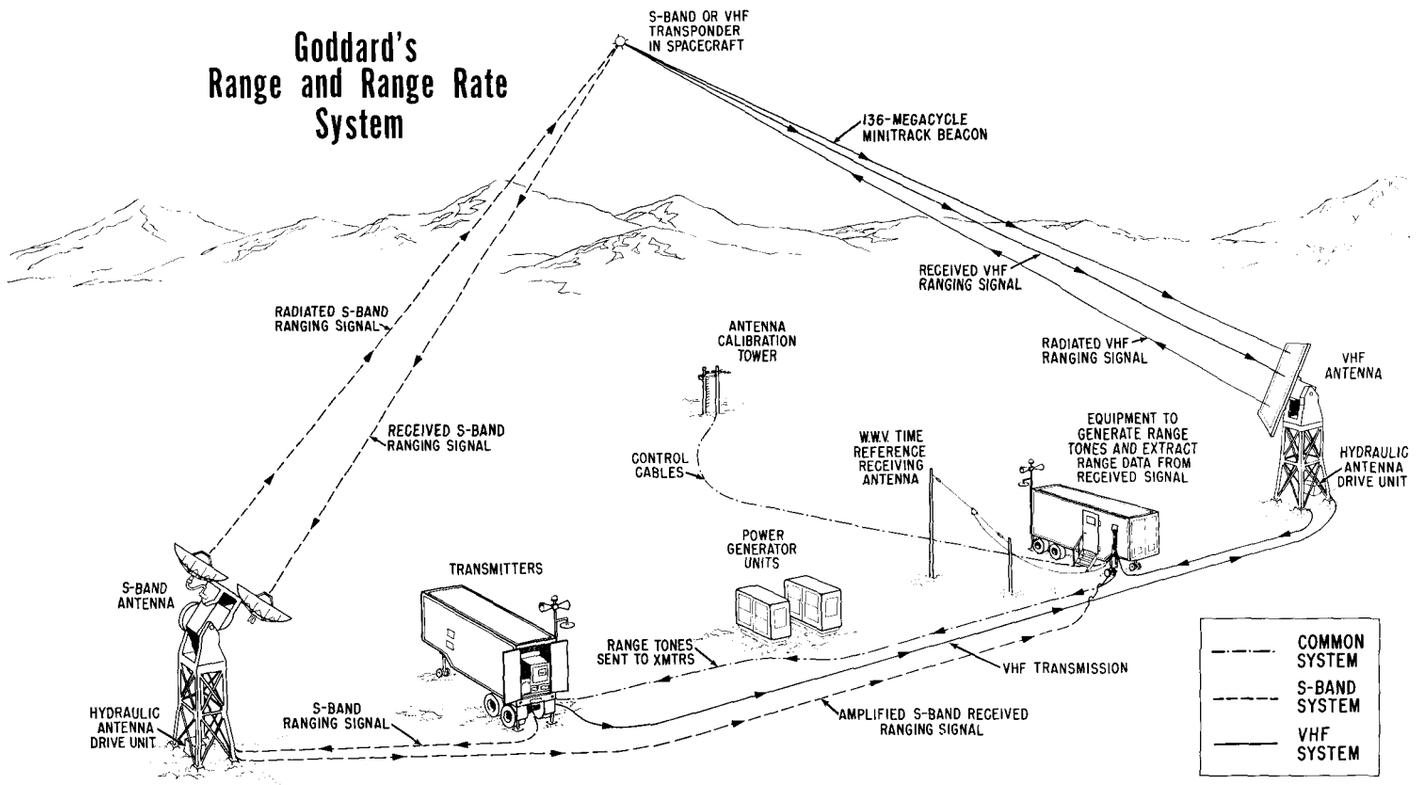
- **Mar. 1, 3 p.m., Auditorium, Bldg. 3—Dr. Roger Gallet, Central Radio Propagation Lab, NBS, Boulder, Colo., "Very Low Frequency Emission".**
- **Mar. 8, 3 p.m., Auditorium, Bldg. 3—Dr. G. R. Ochs, National Bureau of Standards, Boulder, Colo., "Synchrotron Radio Noise at the Geomagnetic Equator".**

**Institute lectures:**

- **Feb. 28, R. Hide, MIT, "Thermal Convection in a Rotary Annulus of Fluid"; C. P. Sonnett, Ames Research Center, "Magnetic Field in the Interplanetary Plasma."**
- **March 5, B. O'Brian, State University of Iowa, "Radiation-Zone Problems for Plasma Physicists."**

**Misc:**

- **Feb. 26, Goddard Wives Club—Peter Connell's Italian Inn, 6221 Annapolis Rd., 7:30 p.m. Election and Installation of Officers.**
- **March 13, Goddard Wives Club—Luncheon and Fashion Show, Park University Motel, Baltimore Blvd., 12 noon.**
- **Film Schedule — Auditorium, Bldg. 3, Goddard, Feb. 28, and at Jackson St., Feb. 26: "The Delta Vehicle" and "Exobiological Safety".**




The less accurate very high frequency (vhf) portion (between 30 and 300 megacycles) of the system is provided for satellites which cannot be equipped with the heavier S-band transponder because of weight limitations. The new system is shown in the illustration.

The Motorola military electronics' division is currently fabricating three complete systems, installed in mobile vans, to permit different geographical deployments for different future satellites programs.

**Locating the Spacecraft**

The vhf antenna automatically sweeps back and forth across a sector of the sky until it locates a satellite by receiving the radio beacon from the Satellite network transmitter onboard.

At this point, the antenna drive system begins an "auto-track" operation in which the antenna continuously points toward the satellite and follows it automatically as it travels over the station.

The position of the S-band antenna is controlled by the vhf antenna through a "servo" system. This arrangement causes the S-band antenna to automatically follow the movements of the vhf antenna until the S-band satellite signal is acquired.

"The S-band antenna is associated with a separate transmitter and receiver on the ground, and an S-band transponder on board the satellite," said Bill Shaffer, assistant project manager. "After the vhf antenna, tracking the satellite network beacon, aims the S-band antenna toward the satellite, S-band ranging can begin. The S-band antenna can then independently auto-track the satellite, using the satellite's S-Band carrier as its target."

**S-band Operation**

In S-band operation, a transmitter located in the van on the left in the illustration is turned on and modulated with tones generated in the receiver van, on the right. This signal, at 2270 megacycles, is beamed from the S-band antenna to the satellite. The onboard transponder receives the signal and transfers the tone modulation to a new carrier at 1705 megacycles. This new signal, which the S-band antenna is following, returns the tone modulation to the ground equipment.

From the antenna the signal passes through a preamplifier located on the antenna tower and arrives at the S-band receiver van.

"The difference between the 'up' frequency and the 'down' frequency prevents interference between the two, either at the ground station or at the satellite," explained Paul Wren, transponder development coordinator for the project.

The receiving equipment removes the tone modulation from the S-band signal and compares it with the tones originally supplied to the S-band transmitter. A time difference will exist, produced by the time required for the tones to travel to and return from the satellite.

The farther the satellite is from the station the greater the time difference between the transmitted and received tones, so time difference is a direct measure of range. Range-rate is obtained by measuring the carrier doppler. The system is coherent, so that the satellites ranging transmitter instabilities are removed.

**VHF Operation**

Range and range rate measurements with the vhf system are made the same as with the S-band system, using a vhf transponder aboard the satellite. The tracking data from both systems is automatically recorded on punched paper tape for transmittal to Goddard by teletype.

Range measurements are time-correlated to a precision time standard which is synchronized to Station WWV national time reference by a WWV receiver in the receiver van. A horizontal dipole antenna to the left of the van is the sensing element for the world-wide WWV broadcast.

An antenna calibration tower supports two radiating antennas, one for S-band and the other for vhf frequencies. Controlled from the receiver van, these antennas, together with transponder simulators, provide a test signal source for alignment and calibration of the two ranging systems.

Single-station operation will allow nearly continuous ranging with the stations separated around the globe, under the orbital path of a satellite. As one station loses sight of the satellite, the next station will begin ranging.

Wesley Bodin, systems development branch head, explained that this scheme will be useful for highly eccentric orbits and for lunar - distance missions, where angle change rate is quite low, but where range and range rate measurements become a more powerful tool. The S-band transponder is designed for optional simultaneous multi-station tracking as well.

Development of the range and range rate system is under the direction of Clarence Schroeder, head of the tracking systems division and Mr. Bodin. Initial design was directed by Edmund Habb, now assistant chief of the space data acquisition division. Working wth Mr. Kronmiller, project manager, are Bill Shaffer, Paul Wren, Ed Hayes, Jr. and Pete Engels.

# *Vatican Astronomer Discusses T Tauri Stars*

***What are the T Tauri Stars?***

The T Tauri stars are faint stars found often in association with bright and dark nebulosity along the Milky Way. Their prototype is the peculiar variable star, T Tauri, so named because it was the third variable star to be discovered in the constellation of Taurus (the first and second variable stars are named R Tauri and S Tauri). The variation of T Tauri was first noted by the astronomer Hind in England in 1852 while he was observing the nearby nebulosity.

Fr. McCarthy

In addition to their association with nebulosity and the marked but irregular fluctuations in their light, the outstanding features of the T Tauri stars are their very peculiar spectra. When the light from these stars is allowed to pass through a glass prism or to be reflected from the surface of a finely ruled grating, it is broken up into its component colors, as in a rainbow, and this process reveals at the same time the atomic elements present in the atmosphere of the star, as well as the physical conditions of temperature, pressure and turbulence prevailing there.

The analysis of the spectrum of the variable T Tauri showed several peculiarities: the lines of hydrogen appeared not as dark absorption lines as those observed in the solar spectrum but as bright emission lines; in addition ionized calcium and sulphur were observed in emission. These peculiarities pointed to remarkable activity in the outer atmospheres of these stars and to a set of physical conditions which are now only imperfectly understood.

In 1942, Dr. A. H. Joy of the Mount Wilson observatory discovered similar peculiarities in 10 other stars which resembled those noted earlier in the star T Tauri; thus he named the group the 'T Tauri Variables'.

Twenty years later, Dr. G. H. Herbig of the Lick observatory published a list of 126 T Tauri stars and related objects. He estimated that there are probably about 12,500 stars like these in the near vicinity of the sun (within one kiloparsec, or 3260 light years, or about 20 million billion miles of the sun).

***Rev. Martin F. McCarthy, S. J., is an astronomer of the Vatican observatory and visiting professor of astronomy at Georgetown University. A graduate of Boston College, Father McCarthy received his Ph.D. in astronomy at Georgetown University in 1951. Prior to his arrival at the Vatican observatory, he visited the observatories in the United States and Canada and was guest investigator at the Warner and Swasey observatory, the Lick observatory and the Dominion Astrophysical observatory. Father McCarthy's fields of specialization include spectral classification of stars, photoelectric and photographic photometry. He is scheduled to return to the Vatican observatory at the conclusion of the current academic year. Father McCarthy spoke at a recent Goddard colloquium. A condensation of his talk, "The T Tauri Stars," is presented here.***

***Where in the galaxy are the T Tauri stars located?***

The T Tauri stars are found close to the central plane of the Milky Way where one notices the concentration of clouds of dust and gas; from these the T Tauri stars may have evolved. The T Tauri stars have been discovered in abundance in the constellations of Taurus, Auriga and Orion and also in Scorpio, Ophiuchus and Monoceros, yet they are strangely absent from the great star clouds in the constellation of Cygnus. Many T Tauri stars have been observed in the extremely young cluster, designated as NGC 2264, which was studied by Merle Walker of Lick observatory. They are never found far above or below the plane of the galaxy.

***What is the size and shape of a T Tauri star?***

The T Tauri stars are approximately the same size as our own star, the sun. They are not massive stars; the range in their masses extends from about three quarters of the mass of the sun to about twice the solar mass. Like most of the other stars, the T Tauri stars are spheroidal in form; perhaps the more rapidly rotating objects might show some evidence of flattening at the poles. The Herbig—Haro Objects (described in more detail below) are non stellar in form and appear on photographic plates as diffuse patches of luminous matter; here, perhaps, we are looking at a T Tauri star in the process of formation.

***Could a spacecraft land on a T Tauri star?***

The surface temperatures on the T Tauri stars are relatively cool by stellar standards, but still warm enough to make any close approach an increasingly uncomfortable process, any landing on the gaseous surface an impossibility and a trip to the stellar interior something to rival a trip to Virgil's or Dante's Inferno. The surface temperatures of the T Tauri stars range from about 3,500 degrees K to about 6,500 degrees K (6,000 to 11,000 degrees Fahrenheit); the central temperatures will be close to 10 to 15 million degrees K (18 to 27 million degrees Fahrenheit).

***How do other types of stars in space resemble the T Tauri stars?***

Most of the stars in the solar neighborhood are quite different from the T Tauri stars. They tend to be much older; their ages are counted in billions rather than in millions of years as is the case for the T Tauri stars; they are much more stable than the T Tauri stars and are almost completely lacking in those activities which are so characteristic of the T Tauri stars: the irregular variations of light and the ejection of material from the surface of the stars.

We know, for example, that, in spite of the great arching prominences and solar flares, our star the sun is really a quiet star and lacks the instabilities of new born stars of the T Tauri class.

***Are the T Tauri stars the youngest objects in the galaxy?***

Most probably they are not. The Herbig—Haro Objects (so named after their discoverers, Herbig of Lick and Dr. G. Haro of the Tonanzintla Observatory of Mexico) appeared on photographs of the Orion region made in 1954, while they had been completely absent from photographic plates exposed in 1946 and 1947.

These Herbig—Haro Objects display features in their spectra similar to those noted in the T Tauri stars. Here we may be witnessing an event close in sequence if not in time to the birth of a star. The current upper limit to the ages of the oldest objects in our own galaxy is set at about 20 to 30 billion years; many generations of T Tauri stars have presumably evolved from the interstellar clouds during this time.

***What problems for future work are suggested by studies of T Tauri stars?***

Many unsolved problems connected with T Tauri type stars remain. Included are an explanation of the variability of light and surface activity, and ejection of material from the stars; the over abundance of lithium compared to that observed in the solar atmosphere; and the reason for the broad diffuse lines observed in the spectra.

# CU Announces Increased Benefits

The NASA Credit Union has approved a 4.6 per cent dividend that will be paid for shares on deposit during the period July 1 to Dec. 31, 1962.

For the future the Credit Union plans to incorporate life insurance for members equalling the amount of shares on deposit up to a maximum of $2,000 at no cost to the member.

In addition, the interest rate on fully secured loans for new automobiles has been reduced to ¾ of 1 percent per month on unpaid balance. This applies only to loan applications processed on or after Feb. 1, 1963.

As a result of the steady growth rate of membership at Goddard, the Credit Union is planning to open a full branch office in the premises in the near future. This is expected to provide additional convenience to members.

New officers elected for 1963 are all from NASA headquarters except second vice president Dick Buckingham of Goddard's project support office. Others are C. H. Townsend, president, accounts and reports branch; Richard Hacker, first vice president, personnel division; Eugene Rosen, treasurer, office of manned space flight, and Catherine Wheeler, secretary, technical committee.

## News About Space & Aeronautics
*—from the other centers and headquarters—*

NASA has selected 88 colleges and universities to receive graduate training grants for the academic year 1963-64. The grants will go to predoctoral trainees who have chosen a graduate study research program that is space oriented. About 800 graduate students will participate in the program. Students will receive a stipend of $2,400 for 12 months of training. There is also an additional allowance for dependents of up to $1,000 per year to be paid according to the policy of the individual university administering the funds. The recipient is assured three years of graduate study providing he maintains a satisfactory record.

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On the recommendation of the Jet Propulsion Laboratory, a repetition of last year's Venus mission, which until now had been planned for 1964, has been eliminated. Concentration will be put on other projects such as the Mars missions, now also planned for 1964, and later Venus missions with advanced Mariner spacecraft.

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A new addition to the Flight Research Center at Edwards, Calif., is the A-5a supersonic jet aircraft. The aircraft, which is on loan from the Navy, will be used in conducting supersonic flights on assigned federal airways and into high air traffic density areas, such as Los Angeles. Results of the flights will help in future control plans for the safe operations of commercial supersonic jets.

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John Sanders, chief of the dynamics and controls branch at Lewis, has made a preliminary design of an interplanetary rocket that can fly through space using only the sun's rays for an energy source. A giant 200-foot-wide aluminized mylar mirror gathers the sun's rays. The reflective efficiency of mylar has been well demonstrated in the Echo communications satellite.

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Morton Stoller, head of NASA's office of applications, was awarded the NASA medal for outstanding leadership. Responsibility for the development and application of meteorological and communications satellite systems, Mr. Stoller has directed the efforts of Echo, Telstar, Relay, Tiros and Syncom.

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Marshall has nominated four employees for three national awards. They are Mrs. Alice Neighbors, aerospace engineer, for the Federal Woman's award; Tom Morring, technical staff assistant, and Robert Pace, engineer, for 1963-64 Sloan Fellowships, and William Fortenberry, for the William A. Lump memorial award.

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Slight changes in the names of Saturn launch vehicles have been made. The original member of the family of three Saturn vehicles, known from its conception as Saturn C1-, will hereafter be called "Saturn I". The Saturn C-IB will now be known as "Saturn IB," and the Saturn C-5 (often called the Advanced Saturn) becomes "Saturn V."

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Langley Research Center has requested proposals from industry to design and construct a prototype 6-month life support system for four men. The system must provide for the crew to live in 2,600 cubic feet of cabin space. The system supporting them must be able to operate for 6 to 12 months, with resupply at 60 to 90 day intervals. A "shirt sleeve" environment must be provided at pressure between 10 and 14.7 psia (normal earth sea level). The contractor will have to determine the amount of drinking and washing water required, food needs, water for preparing dehydrated foods, and ways for reclaiming used oxygen and water.

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Flight Research Center at Edwards has awarded at $3,610,000 contract to Bell Aerosystems Company, Buffalo, N. Y., to design and construct two manned lunar landing research vehicles for project Apollo. The test devices will be capable of taking off and landing under their own power and reaching 4,000 feet. The research vehicles will permit studies of a lunar landing and takeoff. The program will be conducted at Edwards.


*A PROTOTYPE of the atmospheric structure satellite (S-6) gets a wintry exposure to the Goddard atmosphere during systems tests conducted with the assistance of a marine corps helicopter. Building 6 is in the background.*

## S-6 'Copter Tests are Successful

A complete check of the S-6 satellite and its associated ground system has been conducted using a helicopter.

During the test, a computer was used successfully to provide "on-line" real time read-out of telemetered data.

N. W. Spencer, project manager, said it is believed to be the first instance at Goddard in which a computer has been used in an operation of this type, as well as the first time that complete system checks had been made at the Center using a helicopter.

### "Valuable Exercise"

All systems were operated as if the spacecraft were in orbit, according to Mr. Spencer. Orbit signal levels were simulated through the use of attenuators.

"The operation of the total system in a controlled fashion was a valuable and satisfying exercise," he said.

The command and telemetry systems of the spacecraft were commanded on by the Blossom Point, Md., Minitrack station after loading of the prototype and take-off of the helicopter from the building 4 parking lot.

Acquisition of the signal was readily attained by the Blossom Point station. Lock-in of the ground station decomutators in the technical control center in building 2 was accomplished within a few seconds of command.

The demodulated signal was transmitted over the wide-band link to the control center where it was decomutated and printed in numerical form by the project's digital computer.

In a preliminary test, prior to dispatch of the helicopter, data read-out was performed upon command directly from the spacecraft 200 feet over the building 2 parking lot to the control center below.

Between 10 and 20 passes were flown over Blossom Point with the prototype suspended 40 feet below the copter. Altitudes attained ranged between 1,000 and 5,000 feet at distances 35 to 40 miles from the station.

## Tech. Publication Changes Made

Two changes concerning technical publication services by the Goddard library to the center are announced by John Weaver, librarian. They are:

- Technical Publications Announcements becomes Scientific and Technical Aerospace Reports, and will be published on the 8th and 23rd of each month.
- International Aerospace Abstracts, with both format and indexes similar to Scientific and Technical Aerospace Reports will now appear on the 1st and 15th of each month.

Both are distributed throughout Goddard on branch levels.

# MSFS Division Marks Glenn Flight

Goddard's manned space flight support division will say "thank you" in the form of a special informal dinner—dance Friday, March 1, to all who have been a part of the manned flight missions. The occasion marks the anniversary of the first manned orbital flight of Astronaut John Glenn on Feb. 20, 1962.

Sponsored by the division, the event is being held to reacquaint present Mercury team personnel and welcome Goddard newcomers who have joined various elements of the manned program throughout the Center. Invited to attend are support personnel who have assisted in travel, budget, personnel and other manned support functions.

Dinner will start at 7:30 p.m. in the Holiday Inn motel, College Park. A short program and appropriate remarks will follow. Dancing will be from 10 to 2. Reservations and inquiries should be made to Dick Preston, extension 5424.

Planning to attend in conjunction with a 3-day conference of Goddard's manned flight station managers are Otto Womick, Guaymas, Mexico, Dalton Webb, Bermuda; Charles Rouiller, Grand Canary Island; A. E. Smith, Nigeria, and Tom Spencer, Zanzibar.

## Recent Technical Publications Authored by Goddard Staff

K. Stumpff, "Calculation Of Ephemerides From Initial Values," NASA Technical Note D-1415, December 1962.

N. L. Bonavito, "Differential Correction for Vinti's Accurate Intermediary Orbit," NASA Technical Note D-1445, December 1962.

S. H. Crandall, MIT, "On Scaling Laws For Material Damping." NASA Technical Note D-1467, December 1962.

A. E. Bailie and D. Fisher, "An Analytic Representation of Musen's Theory of Artificial Satellites in Terms of the Orbital True Longitude," NASA Technical Note D-1468, January 1963.

T. J. Hennigan and A. O. Apelt, "Use of a Sealed Silver Cadmium Battery on Explorer XII," NASA Technical Note D-1543, January 1963.

M. Dubin, O. E. Berg and W. M. Alexander, "Direct Measurements of Cosmic Dust Showers," NASA Technical Note D-1544, January 1963.

C. E. Fichtel, D. A. Kniffen and K. W. Ogilvie, "September 26, 1960 Solar Cosmic Ray Event," NASA Technical Note D-1675, January 1963.

J. C. Seddon, "Preliminary Report on the Single Station Doppler-Interferometer Rocket Tracking Technique," NASA Technical Note D-1344, February 1963.

K. Stumpff, "On Lagrange's Theory of the Three-Body Problem," NASA Technical Note D-1417, February 1963.

R. A. Stampfl, "The Nimbus Spacecraft and its Communication System," NASA Technical NoteD-1422, February 1963.

H. A. Whale, "The Impedance of an Electrically Short Antenna in the Ionosphere," NASA Technical Note D-1546, February 1963.

P. B. Davenport, "Mathematical Analysis for the Orientation and Control of the Orbiting Astronomical Observatory Satellite," NASA Technical Note D-1668, February 1963.

# Goddard Opens Fund Drives

The 1963 campaigns for the Federal Service Joint Crusade and National Health Agencies open a two-day drive at Goddard March 8 and 11.

The campaigns are being conducted simultaneously and will be confined to a two-day limit to make it more convenient for Goddard personnel, according to Dean Koth of the management services division. Persons not at work either day have until March 15 to contribute.

For these campaigns emphasis is placed on 100 per cent Goddard participation. There are no monetary goals nor suggested levels of giving. Hugh W. Easter, associate chief of the management services division and campaign manager, said the objective is for every employee to make a gift to each drive.

Participating organizations in the Federal Service Joint Crusade are Radio Free Europe, American-Korean Foundation, and CARE. Contributions to the National Health Agencies go to the support of American Heart Association, Muscular Dystrophy Associations of America, National Multiple Sclerosis Society, National Society for Crippled Children and Adults, United Cerebral Palsy Associations, and American Cancer Society.

A contributor may designate the agency of his choice in making a gift. Names need not appear on the envelope unless it is desired.

Contribution envelopes for both campaigns will be distributed on or before March 8.

# 70 Enrolled In Computer Course

Seventy Goddard employees are keeping abreast of current practices in digital computer logic and circuitry design at special weekly sessions of a Goddard-sponsored in-service course.

Instructors in the course are Jack McReynolds, digital logic systems engineer in the astrophysics branch, and Dr. Yaohan Chu. Because of the high interest in the course, Dr. Chu, lecturer in computer courses in the electrical engineering department at the University of Maryland since 1946, is teaching the extra session to share the teaching load. Each class meets weekly for about two hours.

Chu

Participants are benefiting by use of a newly published text book authored by Dr. Chu. The title of the book is "Digital Computer Design Fundamentals" published last October.

Dr. Chu is also manager of digital systems in the RCA data systems center in Bethesda. A native of China, Dr. Chu has been in the United States 18 years. He received his Ph.D at the Massachusetts Institute of Technology in 1953.

About half of those enrolled in Dr. Chu's section represent the space data acquisition division, including Dr. Robert Coates, division head, and Edmund Habib, assistant head. Tracking systems, test and evaluation, and data systems division personnel comprise other course members.

# Space Appreciation Course To Open

A non-mathematical survey of the physical sciences geared to non-technical Goddard personnel will be taught in weekly sessions beginning tonight.

Chuck Jones, employee development specialist in the employee development branch, said that the purpose of the course is to enable Goddard support personnel who work closely with scientists and engineers to acquire a better grasp of basic concepts and terminology of the physical sciences.

Major topics to be taught consist of motion and forces, planetary systems, electricity magnetism, heat and conversion of energy, atomic theory and modern physics.

Instructor for the weekly sessions, scheduled for Mondays from 4:30 to 6 p.m., will be Dr. John Phelps, visiting associate professor in the physics and astronomy department of the University of Maryland.

# Safety Awards Given

Safety awards for Goddard's second full year of operation were presented in special ceremonies last week.

Winners of certificates for having no disabling injuries during 1962 were the machine and sheetmetal branches of the fabrication division; the thermodynamics, electronics test and structural dynamics branches of the test and evaluation division, and the plant engineering branch of the facilities engineering division. In addition, two drivers, Oliver Cain, Jr., and James Fleming, of the storage and transportation branch, management services division, won awards.

*SAFETY AWARD recipients are, left to right, Phil Yaffee, electronics test branch; Malcolm Tarlton, accepting for plant engineering; Fred Taub, machine branch; Dr. Michael Vaccaro, assistant director for administration, presenting the certificates; Harry Bickford, sheetmetal branch; Bob Wyatt, accepting for Messrs. Cain and Fleming; Henry Maurer, accepting for thermodynamics, and Ed Kirchman, structural dynamics branch.*