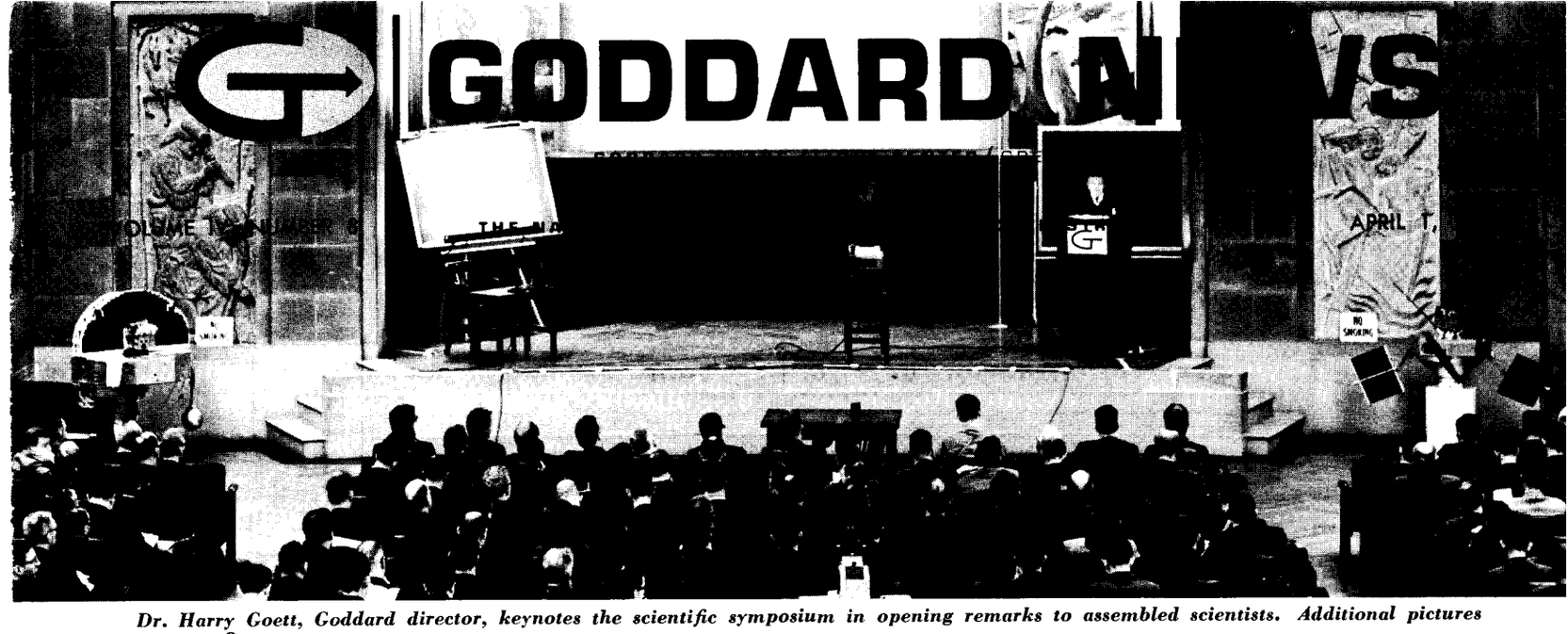


Dr. Harry Goett, Goddard director, keynotes the scientific symposium in opening remarks to assembled scientists. Additional pictures on page 8.

GSFC

Symposium Attracts Record Turnout

With more than 600 representatives of the national and international scientific community in attendance, Goddard's first scientific satellite symposium lived up to advance expectations with an auspicious performance in the Department of the Interior auditorium March 13-15.

On hand for the consolidated preliminary review of the scientific findings from Alouette, Ariel, OSO, and Explorers XII, XIV and XV were representatives of the United States and 12 nations — Argentina, Australia, Belgium, Brazil, Canada, France, India, Italy, the Soviet Union, Sweden, Switzerland and the United Kingdom.

Pleased with the results of the symposium, Dr. Leslie Meredith, head of the space sciences division, and chairman of the event, looked to the possibility of a second symposium a year hence to appropriately highlight and interrelate findings from Goddard's upcoming scientific spacecraft—S-6, S-17, S-48, S-66 and S-74.

Describing the symposium as "very profitable", Dr. Meredith said particular benefit was gained by the interrelationships established between various scientists who had experiments aboard the respective spacecraft. These relationships, such as that established between radiation belt measurements and the ionosphere, were brought out for the first time during the course of the symposium.

An evening buffet dinner midway in the symposium was attended by an estimated 200 registrants and their wives, including NASA Administrator James Webb.

Highlights of the sessions include the following scientific findings:

Alouette

Soundings from the topside sounder have shown the ionosphere to be rough in the high latitudes north and south of 50 degrees and smoother in the lower latitudes. The sounder findings that the electron temperature in the ionosphere depends on latitude indicates another heat source, possibly caused by Van Allen belts precipitating particles into the atmosphere in the ionosphere and raising its temperature. This results in "spread F"—where the two F layers of the ionosphere become more widely separated, causing radio waves to be scattered rather than smoothly reflected.

Ariel

The ionospheric electron density experiments detected the same temperature dependence on latitude as Alouette discovered. The solar X-ray apparatus indicated that solar flares appear to have two phases. The data was interpreted to mean that in the first phase, the corona is heated above a flare-producing sunspot, increasing X-ray flux by a factor of 10 above normal, while in the second—after a quiescent period marked by the flux leveling off at its raised value—streams of electrons thrust down into the chromosphere, causing Bremsstrahlung emission of X-rays at a flux 500 times greater than normal.

OSO

OSO detected regular and predictable patterns in the eruption of small microflares from the sun, as seen in emission of X-rays. As a result, it is possible to predict when one microflare will follow another within one minute of actual occurrence.

Uutraviolet spectral measurements were interpreted to show that solar disturbances have a greater electron density than undisturbed areas.

It also was discovered that a number of radiation belt "warm spots"—areas where the electron flux is 30 times greater than average—exist in addition to the South Atlantic "hot spot", whose existence had been established previously. These areas are located over Madagascar, Western Australia, Eastern Australia, northwest of Hawaii, off Baja, California, and over the South Pacific. Preliminary analysis suggests that these regions correspond to anomalies in the earth's magnetic field which permit the Van Allen belts to descend to unusually low altitude.

Explorers XII, XIV, XV

Data was presented which confirmed the existence of a ring current of low-energy protons circling the earth in a westerly direction—drifting perpendicular to their perpetual north-south spiraling motion along the geomagnetic field lines. The ring current established produces a permanent 40-gamma depression in the intensity of the geomagnetic field at the geomagnetic equator. In addition, magnetic storms—abrupt breaks in the geomagnetic field intensity following solar flares—are probably caused by a solar-plasma-induced ring current.

Cosmic ray experiments on Explorers XII and XIV provided measurements of several cosmic ray bursts produced by the sun. The characteristics of one of these cosmic ray events suggested that at first the solar cosmic rays were partially trapped near the sun and only slowly allowed to leak away into interplanetary space; and that later, after a sudden change of conditions at the sun, they were allowed to escape freely. At another time an echo of an event was observed after one rotation of the sun.

State University of Iowa experimenters Van Allen and Frank reported on results from their Explorer XIV data which showed that the trapped particle region is shaped, presumably by the solar wind, into a teardrop with the pointed end away from the sun. Theorists, notably Axeford and Hines of Canada, have predicted such an effect on the magnetosphere. The SUI results further show that a large region within the pointed end of the teardrop is devoid of trapped particles.

Gulliver's 'Sticky String' to Give Man First Clues of Life on the Planet Mars

Gilbert V. Levin is vice president of Resources Research, Inc., Washington, D. C., a firm specializing in environmental research. With the firm he has worked on a number of water supply, air pollution, and sewage disposal problems for federal and local governments and private groups. He conducted a study of Washington area water and sewage problems for the U.S. Congress. He has originated and directed a number of laboratory research projects, including the conversion of saline water by physical adsorption and by trying to induce algae to take up sodium chloride; the harvesting of algae; and the development of a method to detect extraterrestrial life through instrumented landings on other planets. He is author or co-author of 30 publications in sanitary engineering, sanitary biology and exobiology.

Mr. Levin is a civil and sanitary engineering graduate of Johns Hopkins University and has served in a number of public health positions, including civil defense coordination for the D.C. department of health. He has been a researcher and lecturer at Georgetown University.

A condensation of Mr. Levin's talk on "Exobiology" to the weekly Goddard colloquium on Friday is presented here.

If we want to detect life in the universe, what do we consider life to be?

Biologists now generally agree that life is any self-replicating, substantive system which has the ability to mutate and pass the mutated characteristic onto its progeny. The mutation aspect is especially important. Otherwise, various mechanical or chemical models designed with, or having, the ability to produce replicates of themselves could qualify as living organisms.

What is Gulliver?

Gulliver is a miniature probe designed to search for life on Mars. It will specifically look for microorganisms through the use of highly sensitive radioisotope techniques. After landing in a capsule, the two pound device will fire 25-foot lengths of "sticky string" onto the surface of Mars. The string will then be reeled back into the instrument bringing with it tiny particulate matter which, on **earth,** would be expected to contain microorganisms. A radioactive, nutrient broth, developed to support a wide variety of microorganism species, will then be added to the particulate matter.

Any life present, if at all similar to life forms on earth, should ingest some of the nutrient, consequently giving off radioactive carbon dioxide or other labeled gases. These gases would be collected, and the radio activity measurements transmitted to earth. A duplicate instrument, similarly operated but injected with a poison, would serve as a control.

If the signals from the test instrument describe the characteristic exponential curve of growth and the control curve is attenuated, the existence of life will be strongly indicated. Even if the organisms do not grow during the test period, their respiration will reveal their presence when the data produced is compared to those from the control. Recently, Gulliver has been modified to permit the detection of photosynthetic activity.

Why is your experiment designed to look for microorganisms?

There are two principal reasons Gulliver was designed to look for microorganisms. First, it is more likely that microorganisms could exist in the absence of macroorganisms than vice versa. If there were no microorganisms, or some similar mechanism, to decompose the organic matter in macroorganisms, the life process might cease when a large portion of the available foodstuff became stock-piled on living and dead macroorganisms.

Secondly, microorganisms on another inhabited planet would probably, as on earth, be far more plentiful, more widely distributed and easier to catch than macroorganisms. Furthermore, experiments have shown that some microorganisms grow in a simulated Martian environment.

Would the device detect life in all locations on earth, e.g., snow, desert, rock?

Gulliver, or the basic system used in him, has been tested on such apparently adverse life environments as snow, desert, sand, asphalt paving and a plate glass window. In each of these instances, a positive response was obtained, although in some cases the determination took longer than it routinely does for soils in fields or woods.

What distinctive characteristics do you expect to find in Martian life?

I would guess that Martian life would require little or no oxygen, would be quite efficient at collecting and retaining water, and would consist of organisms requiring organic compounds from the environment and, possibly, photosynthetic organisms as well.

We know there is very little oxygen in the Martian atmosphere. Can you visualize life without oxygen?

There are species of microorganisms on earth which do not require respiratory oxygen, indeed, are poisoned by it.

Life on earth is related to the element carbon. Can you visualize life based on other elements?

Many persons have speculated upon life based on silicon or other elements. However, because it offers the greatest possible number of combinations to form complex molecules and because it is known to be widely distributed in the universe, carbon is a good first bet.

If life is found on Mars, is it an ancient or fading out version caused by the loss of water vapor?

Press reports of recent spectroscopic observations of Mars attribute some, but little, water vapor to it. Whether this amount was, or has become, limiting to the evolution of increasingly complex forms of life is anyone's guess. However, if life exists on Mars, it is unlikely to be further advanced than we are, or it would have made itself known to us directly or possibly indirectly through our telescopic observation of large artifacts, or through reception of radio signals intended for use on the planet.

How do you know that your experiment will measure Martian organisms and not those carried by the experiment?

Every possible effort will be made to preclude the carrying of living earth organisms on or in the Mars space capsule. The present plan calls for heat serilization of the entire spacecraft. These extensive precautions will be taken not only to protect the integrity of the experiment but, more importantly, to prevent the possible contamination of Mars with an alien life.

Could man be infected by Martian germs, perhaps exposed to a "Martian flu" or unknown diseases?

If Martian microorganisms exist, it is possible that man could be susceptible to them. This might be especially true if life on Mars and earth share a common ancestry.

Is it possible that life on Mars could survive the much higher level of ultraviolet intensity from the sun?

Ultraviolet intensity on Mars could be counteracted by protective coatings evolved by the organisms there. On the other hand, the organisms may have selected the underside of soil particles or subsurface environments for their habitat. It also is possible that, because of condensation, water would be more plentiful in these places.

Is it possible for humans to live on Mars?

It would be very difficult for earth humans to live on Mars. However, if they brought with them a completely closed environment, such as is now being developed for spacecraft, it might be possible to sustain men.

What kind of life forms would you expect on Venus?

Recent temperature information on Venus offers little hope for life as we know it. However, it has already been speculated that microorganisms might exist in the atmosphere at elevations where the temperature was less severe. I might hazard the additional speculation that anaerobic organisms might live beneath the surface of Venus at depths where the temperature is in an acceptable range.

(GULLIVER, continued on page 8)

Goddard's sheet metal branch occupies the rear and the sides of the east wing of building 5. Machine branch facilities are in the foreground.

Sheet Metal Branch Thrives on Challenge...

The phone jangled in the fabrication division's sheet metal office.

"Harry, we've got a top priority job that has to be done 'yesterday.'"

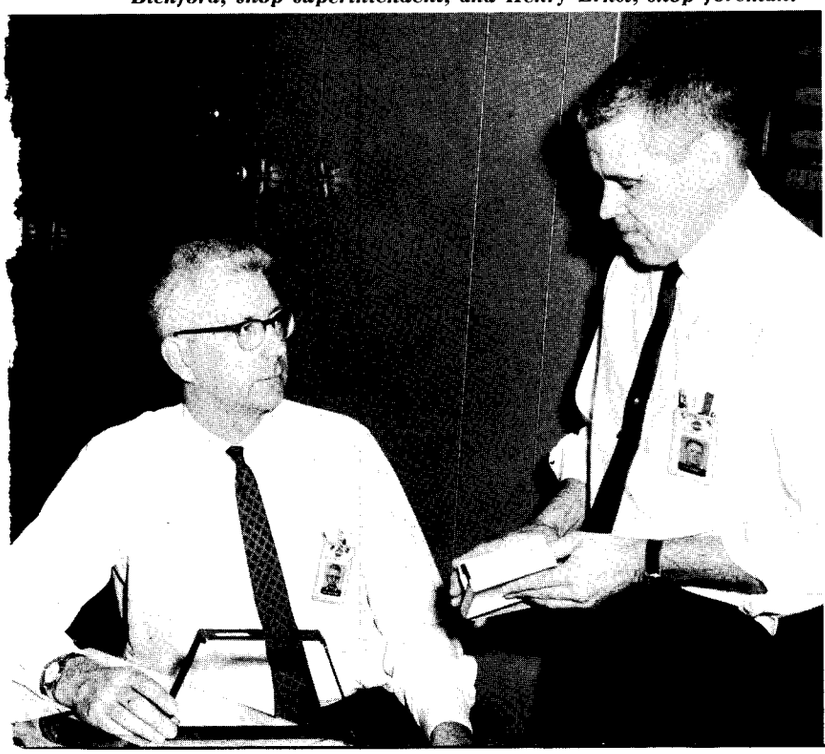
For Harry Bickford, superintendent of the sheet metal branch, the call was the beginning of another of many challenges in which the sheet metal branch has been involved since it was organized in 1959.

This time the project was "tave", (an acronym for Thor Agena vibration experiment) and the voice on the other end of the phone was Jim Rice, fabrication division planning officer, who coordinates projects and schedules for the division.

Urgency of the project was caused by the need to obtain in-flight data on the vibration environment of the Thor-Agena B launch vehicle.

Seven days following the telephone conversation, fabrication division personnel had successfully met another deadline. The sheet metal branch had constructed a flight-qualified payload from scratch and in the process compiled a record 1145 man-hours of effort as the team worked round the clock.

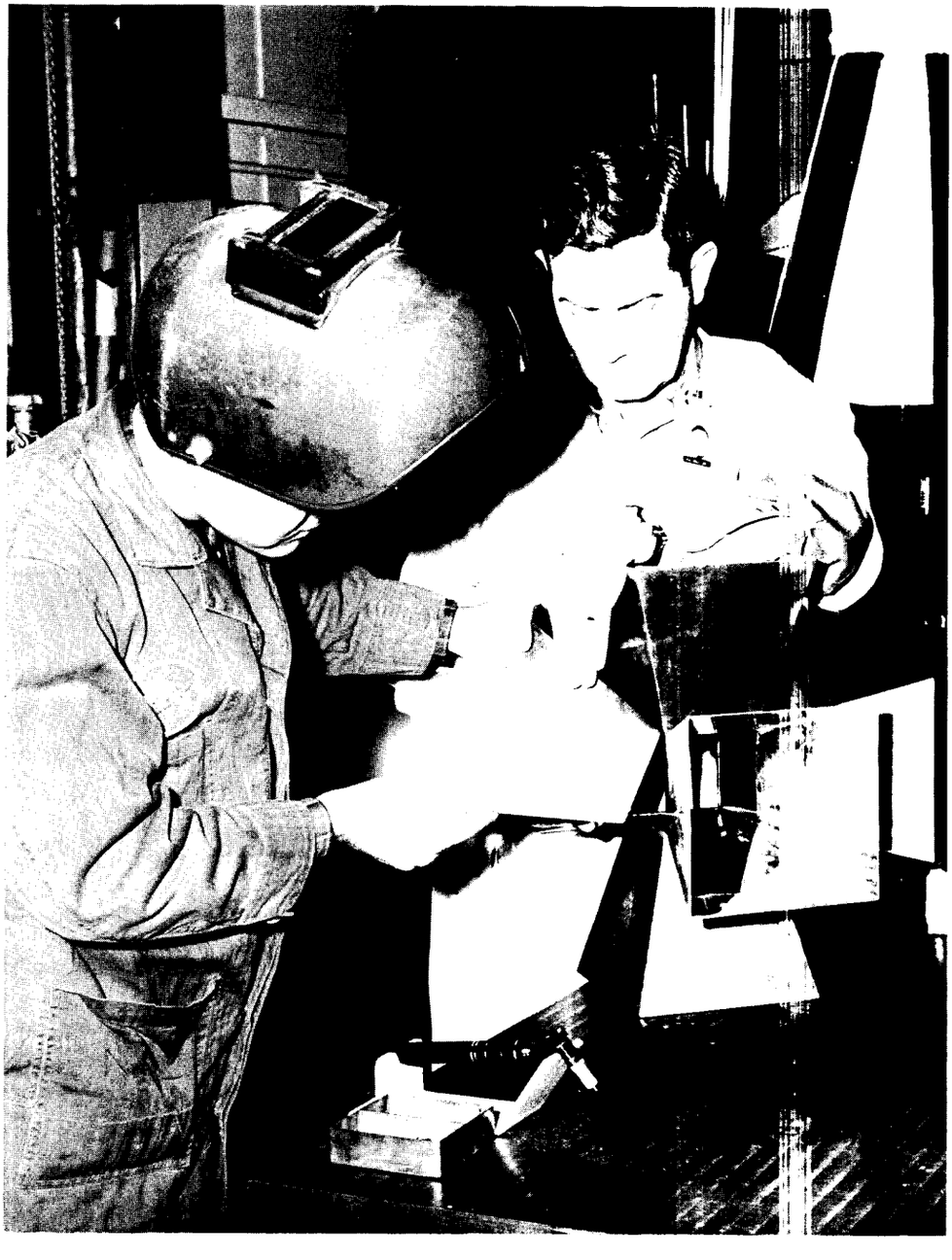
Progress on sheet metal branch projects is discussed by Harry Bickford, shop superintendent, and Henry Ernst, shop foreman.



A sheet metal fabricator "Heliarc" welds an aluminum Aerobee instrumentation rack.

Leroy Wolf, metal fabricator, welds a seam in a 36-inch diameter hemisphere. Bill Kohlhafer, aviation metalsmith, holds the parts in place.

Sidney McClure, welder, and Frank Gill, aviation metalsmith, fabricate and assemble individually gold-plated pyramids into an omni-directional anisotropic chamber.



Unique Talents and Faci

Experienced Personnel

Assigned to build experimental models, prototypes, and components of satellites, as well as perform all related sheet metal, welding and model finishing, the branch is uniquely staffed with experienced personnel, equipment and facilities.

"We're expected to be able to stretch, form, shape and join all metals required in a spacecraft, and to build one as well," said Harry Bickford. "We have the capabilities and talents to do both."

The 30 branch personnel have an average of 15 to 20 years experience gained in aviation metalsmithing, coppersmithing, ship modeling, and welding of exotic materials and shapes.

Because of the wide background of experience and "know how," the flight hardware produced has met the high standards required in all Goddard projects. Included in the long list of capabilities of the branch are:

- A unique 16-by-48 inch gap bed machine lathe with multi-purpose features, including a "tracer" to adjust the cutting tool for contours and tapers, and a hollow spindle to handle a tube or shaft 5 inches in diameter and unlimited in length.
- A rapid brazing process—aluminum dip brazing—to join thin or thick sections of aluminum without distortion. This technique will have wide application in the manufacture of wave guides, brackets, frames, modules and enclosures. It permits the accomplishment of work previously not possible in the branch as well as the accomplish-

Donald Voelker, aviation metalsmith, rivets a clip on a bench hand-formed bracket to be used in an Aerobee nose cone.

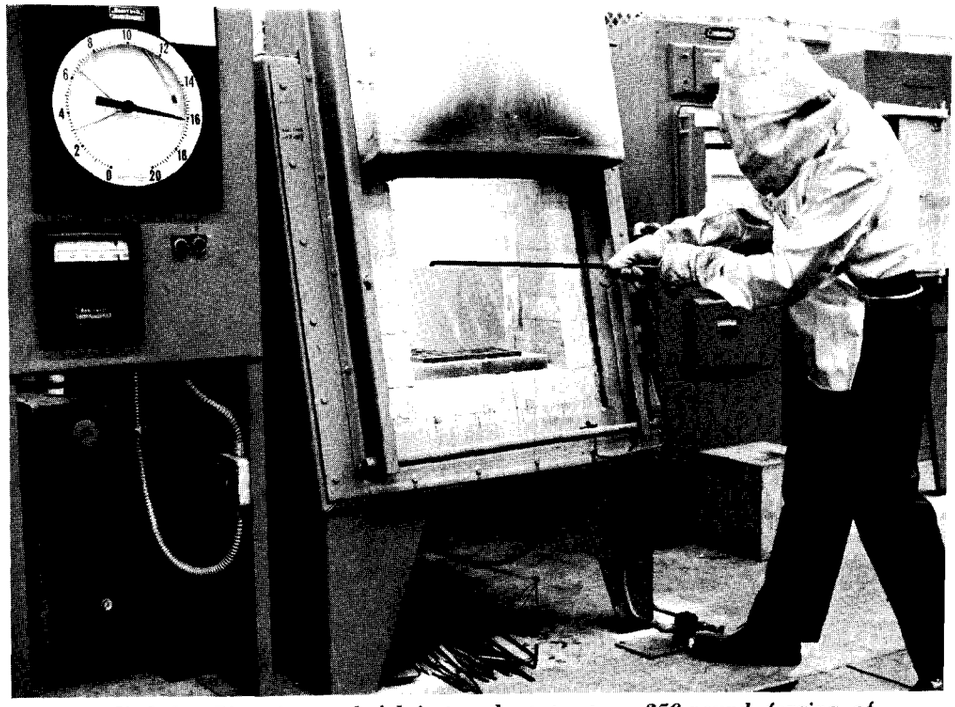
ities Get Grade A Results

ment of conventional jobs more rapidly and economically.

- A yoder hammer which has revived an ancient technique of metal forming, in that it places complete emphasis on the skill of the artisan in shaping metals to desired curvatures. (Goddard News, Feb. 25).
- A machine which can "stretch" or "shrink" metals to prescribed limits. By "cold working" the metal, strength is added to the materials.
- A multiform bender, especially useful for miniature parts, is producing standardized module frames accurate enough to be interchangeable with any other frame without the use of dies. An estimated 1,000 of the frames have so far been made for use in the interplanetary monitoring probe (IMP) and other spacecraft projects.
- A metal rolling machine with 6-by-48-inch solid rolls can shape a flat sheet of metal into a perfect tube in a manner similar to putting clothes through a ringer. After computing precisely the correct length of the metal, a piece is cut which, after rolling on the machine, forms a perfect cylinder.

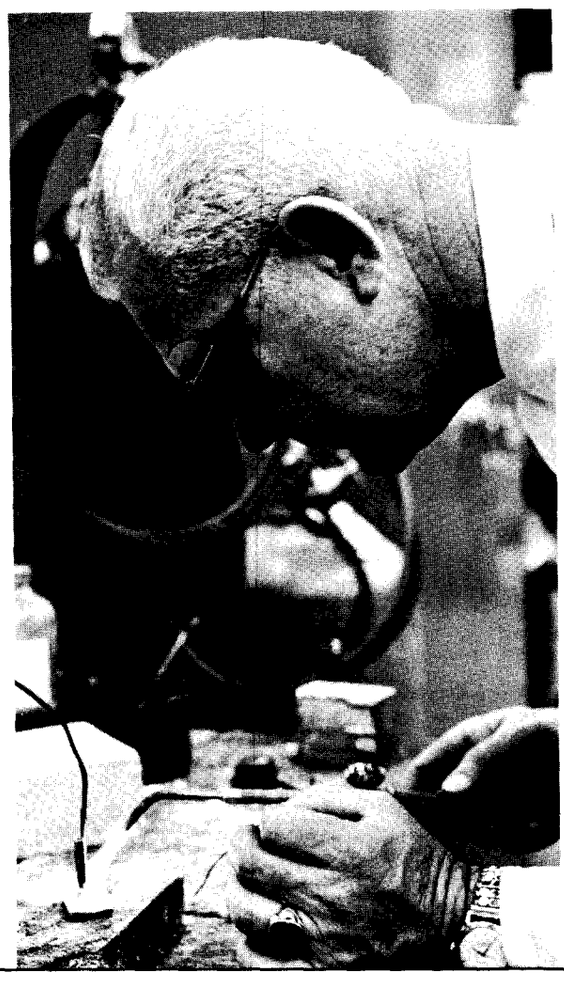
Maurice Levinsohn, chief of the fabrication division, is justly proud of the performance of the personnel in the sheet metal branch.

"We are working at the latest state of the art in aero-space fabrication technology and are developing new techniques to meet future requirements of more advanced Goddard projects," he said.

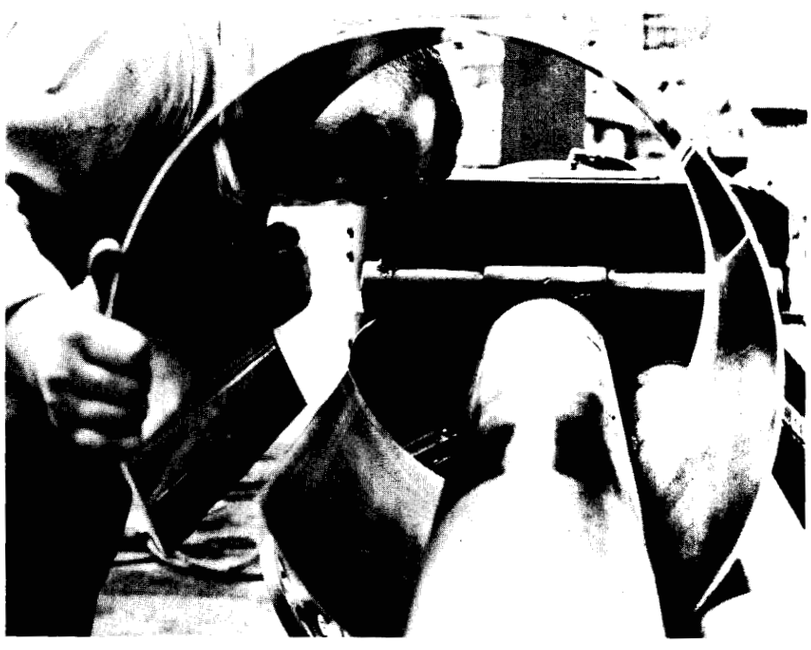


Nicholas Piegari, metal fabricator, heat treats a 250-pound forging of stainless steel at 1650°F in the Coates electric furnace.

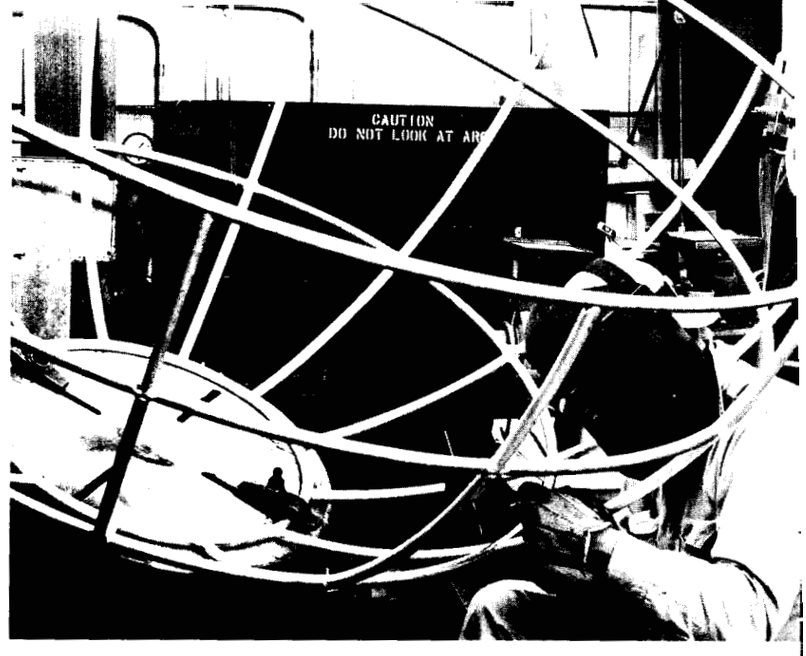
Wiley Jenkins, metal fabricator supervisor, uses an oxygen-acetylene torch to silver braze a copper fitting. The torch produces a flame in excess of 5,600 degrees.



An inert gas gun used in welding an aluminum fixture produced this display of fireworks photographed by a Goddard cameraman.



Burton Kelbaugh, aviation metalsmith, forms a 20-inch diameter aluminum cylinder on the metal rolling machine.



Anthony Votta, metal fabricator, uses a heliarc torch to weld an aluminum tubing frame for a 6-foot sphere.

The Artisan's Careful Skill — A Must in a Fast-Moving Age . . .

William Peed, aviation sheetmetal worker, fits a door in an Aerobee nose cone. The black covering on the cone protects the highly polished surface.

Frank Martin, model finisher, sprays conductive silver on the dome for the UK–2 satellite.

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

Astronaut John H. Glenn, Jr., first U.S. astronaut to orbit the earth, received the 1963 Robert H. Goddard trophy March 22 at the Robert H. Goddard memorial dinner. The award is given annually in commendation of the "greatest achievement during the preceding year to advance missile, rocket and space flight programs." Vice President Johnson was the principal speaker at the Sheraton-Park hotel dinner.

• • •

A NASA office of assistant administrator for technology utilization and policy planning has been established. The office will emphasize the program which NASA has been developing to make more readily available scientific and technological advances resulting from the space program for use in the nation's economy.

Dr. George L. Simpson, Jr., assistant administrator for public affairs, will fill the new post. Julian Scheer, deputy assistant administrator for public affairs, will be the deputy assistant in the new office.

Dr. Simpson's public affairs duties will be expanded to include direction of the industrial applications division of the office of applications. The division is redesignated the office of technology untilization under the new organization. Louis B. C. Fong, who has directed the industrial applications division, will be the director of technology utilization.

• • •

Captain Robert F. (Frederick) Freitag (USN), 43 joins NASA headquarters this month as director of launch vehicles in the office of manned space flight. He replaces Milton Rosen, who joins the staff of Admiral W. F. Boone, NASA deputy associate administrator for defense affairs, as a senior scientist.

Freitag, headed a Navy unit which in 1954 planned and established the Polaris program. In 1959, he received a Legion of Merit for his work in various missile programs.

• • •

Ames Research Center has asked industry to study the feasibility of using a series of earth satellites to conduct biological experiments upon plants and animals under an extended weightless environment.

One phase of the program already approved envisions a study of a series of six bio-satellites, to be launched during a period of 18 months, with flight durations of from three to 30 days. Each of the payloads of such bio-satellites would be recovered and returned to the experimenters for post-flight study. Experiments that might be performed are being evaluated.

Experiment objectives would include the reactions of animals to prolonged periods of weightlessness; the effects of weightlessness or removal from the earth's rotation on the biological rhythms and cellular processes of plants and animals; and whether the condition of weightlessness has an effect on the susceptibility of plant and animal specimens to radiation damage.

• • •

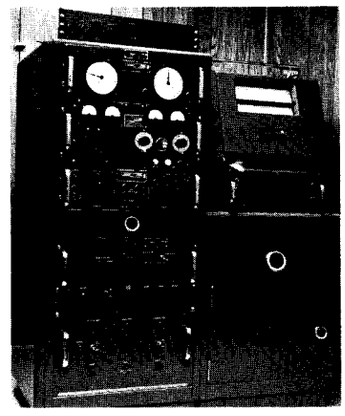
Scientists at the Propulsion Laboratory hope to use oilfield exploration techniques to determine the composition of the moon to a depth of 500 feet, using small controlled explosions.

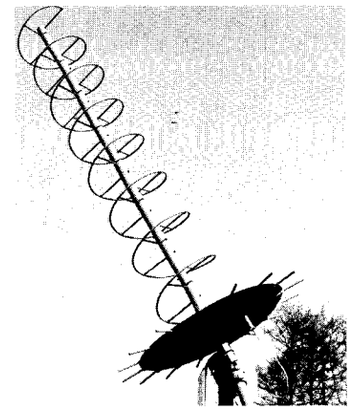
Francis E. Lehner, senior project engineer on lunar seismology at the California Institute of Technology, and Dr. Robert L. Kovach, a geophysicist, are developing a system for gathering data on the moon's crust for NASA.

"The system is designed to be flown to the moon in an unmanned instrument package weighing about 50 pounds," Lehner said. "Possibly, it could be part of the scientific program when astronauts land on the moon.

"We propose to obtain subsurface information about the moon by touching off a series of small explosive charges, and then, with one or more geophones placed at varying distances from the explosion, detect the resulting waves that have penetrated into the crust and have been refracted again to the surface."

A geophone converts a mechanical wave into an electrical one that may be amplified and recorded. Different kinds of rock formations and cracks, and layers of materials will affect the wave patterns which can be amplified and radioed back to earth.





Modest ground station equipment capable of receiving Tiros and Nimbus pictures consists of a 15-foot helical antenna, right, and console. Those possessing the equipment will be able to receive weather data transmitted by the automatic picture system in the spacecraft. The antenna and console have been on display by Fairchild Stratos, contractors for NASA for the ground station equipment.

Seven More Tiros on the Way

Production of seven new Tiros weather satellites has started under a contract with RCA Astro-Electronics division of Hightstown, N. J.

Five of the new spacecraft eventually will orbit along-side six existing Tiros plus two scheduled for launching under the present program later this year. It will bring to 13 the total number of Tiros that eventually will orbit the earth.

Of the five new Tiros planned for launching, three will be research and development versions and two will be operational. In addition, the contract calls for two spare satellites.

The operational Tiros will carry television cameras only and supporting equipment for daytime picture taking, according to Bob Rados, Tiros project manager. They will be identical to Tiros 5 and 6, launched last June and September, respectively.

To Improve Instrumentation

The research and development versions will be used to improve instrumentation and systems for satellite weather data acquisition. Mr. Rados said that consideration is being given to launching the Tiros satellites into elliptical, high elliptical and polar orbits, with other configurations a possibility.

While these Tiros will be primarily for research, it is intended that they will transmit operational weather data as well.

"If they achieve both r & d and operational objectives, everyone will be most satisfied with the accomplishment," said Mr. Rados.

Launch of the r & d and operational spacecraft will be interspersed to permit uninterrupted weather surveillance of the earth.

Automatic Picture Transmission

Under the present Tiros program, a future spacecraft will contain for the first time automatic picture transmission capabilities. The new system will be checked out on the Tiros prior to being added to the more advanced Nimbus spacecraft.

Automatic picture transmission enables weather pictures to be transmitted to the ground immediately, thus avoiding the delay of storing them on tape for read-out later on.

"The pictures are to be transmitted directly to earth and can be received by anyone with a modest amount of ground station equipment," Mr. Rados said. (See picture)

Scheduled to be added to the two stations which make up the Tiros ground station network is a third at Gilmore Creek, Alaska. The new site will utilize the present 85-foot antenna facility at Fairbanks preliminary to the Nimbus operation. Tiros read-out presently is performed at Wallops Station and Pt. Mugu, Calif.

Goddard News

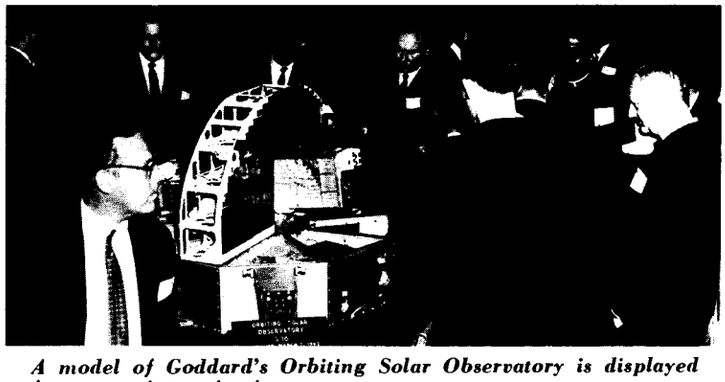
The Goddard News is an official biweekly publication of the Goddard Space Flight Center, Greenbelt, Md.

Editor .....Wesley Dibbern
Phone .....Ext. 4141 or 4142

Pictures Highlight Symposium Action

A part of the more than 600 scientists registered for the symposium crowd the Interior department auditorium.

J. A. Van Allen leads an informal discussion during the Explorer satellite sessions of the symposium.



A model of Goddard's Orbiting Solar Observatory is displayed for symposium scientists.

Goddard gals giving support to symposium activities demonstrate how they hitched a bus ride after their car developed a flat tire on the parkway. They are Alberta Moran, Marie Matthews, Mildred Hazard, Evelyn Vaughn, Dyanna Harris, Mary Rogers, and Marilyn Horine.

(GULLIVER, continued from page 2)

The energy source might be heat conducted from the surface. This speculation is merely to demonstrate that it may take considerably more effort to prove that life does *not* exist on the planet than to prove that it does.

Do you think life exists on other planets in the solar system and the universe?

I think that some lower forms of life exist on Mars. This is a **thought,** not a statement. The latter would be very bold based on the information available, and especially in view of the fact that such a statement can no longer be made with the impunity enjoyed by former generations. With regard to the universe, primarily on the basis of the statistical concept, I think it probable that life comparable or superior to our own exists in other solar systems.

Would you reply to signals from outside our solar system, if we received them, or remain quiet for fear of exposing ourselves to domination of more intelligent beings?

I have frequently been put to considerable trouble as a result of answering the telephone. However, even the benefit of such experience does not permit me to let the phone ring unanswered. If the inter-galactic telephone should ring, I am afraid that I would succumb to the highly improbable possibility that, during the infinitesimal period of my existence, I might gain some momentous insight into the nature of the universe.

Referral Cards List 300 Names

Letters have been sent to more than 300 persons recommended by Goddard employees as prospective candidates for positions at the Center.

The more than 300 names were submitted on colleague referral cards attached to the pay checks of all employees in February. Purpose of the cards was to elicit the help of employees in recruiting 250 scientific, engineer, technician and administrative personnel.

Each letter contains a form 57, information about Goddard, an invitation to return it, and an explanation that his name was suggested by a friend or associate employed at Goddard.

John P. Soden, chief of the placement branch, said the response received was most appreciated and encouraged those who haven't returned their cards to do so now, or call 4821.

Underlying the basic concept behind the referral card technique is the belief that the best way of making Goddard known to job candidates is through those who work here and know what the Center can offer a job applicant and vice versa.

Use of the referral cards has resulted in a suggestion from NASA headquarters that cards be sent to other NASA centers for their consideration as a recruiting device.

Goddard Coming Events

Goddard colloquium lectures:

- **April 5, 3 p.m., Auditorium, Bldg. 3—Dr. S. Fred Singer, Director, National Weather Satellite Center, U.S. Dept. of Commerce, Weather Bureau, Washington, D. C. "What Is New In The Exosphere."**
- **April 12, 3 p.m., Auditorium, Bldg. 3—Dr. Gordon H. Pettengill, Lincoln Laboratory, Lexington, Mass. "Radar Investigations of Lunar and Planetary Surfaces."**

Misc:

- **Goddard Wives Club—Dinner Dance—April 27, 7 p.m., Gourmet Restaurant, 8601 Baltimore Blvd.**
- **Film—Jackson Street, April 2, "The Orbiting Solar Observatory."**

Goddard Speech and Paper Presentations

(Technical presentations approved as of March 27 for period of April 1 thru April 14)

SPEECHES

Charles E. White, spacecraft systems branch, ARS-AIAA, April 1-3, Palm Springs, Calif. ***"OAO Structures."***

Walter J. Carrion, optical systems branch, American Ordnance Association, Lasers/Masers Symposium, April 4-5, New York. ***"Real Time Automatic Digital Optical Tracker."***

PAPERS

William W. Wolman, systems review group, American Society for Quality Control, April 2, Washington, D. C. ***"Realiability Analysis for Space Systems."***