GODDARD NEWS

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

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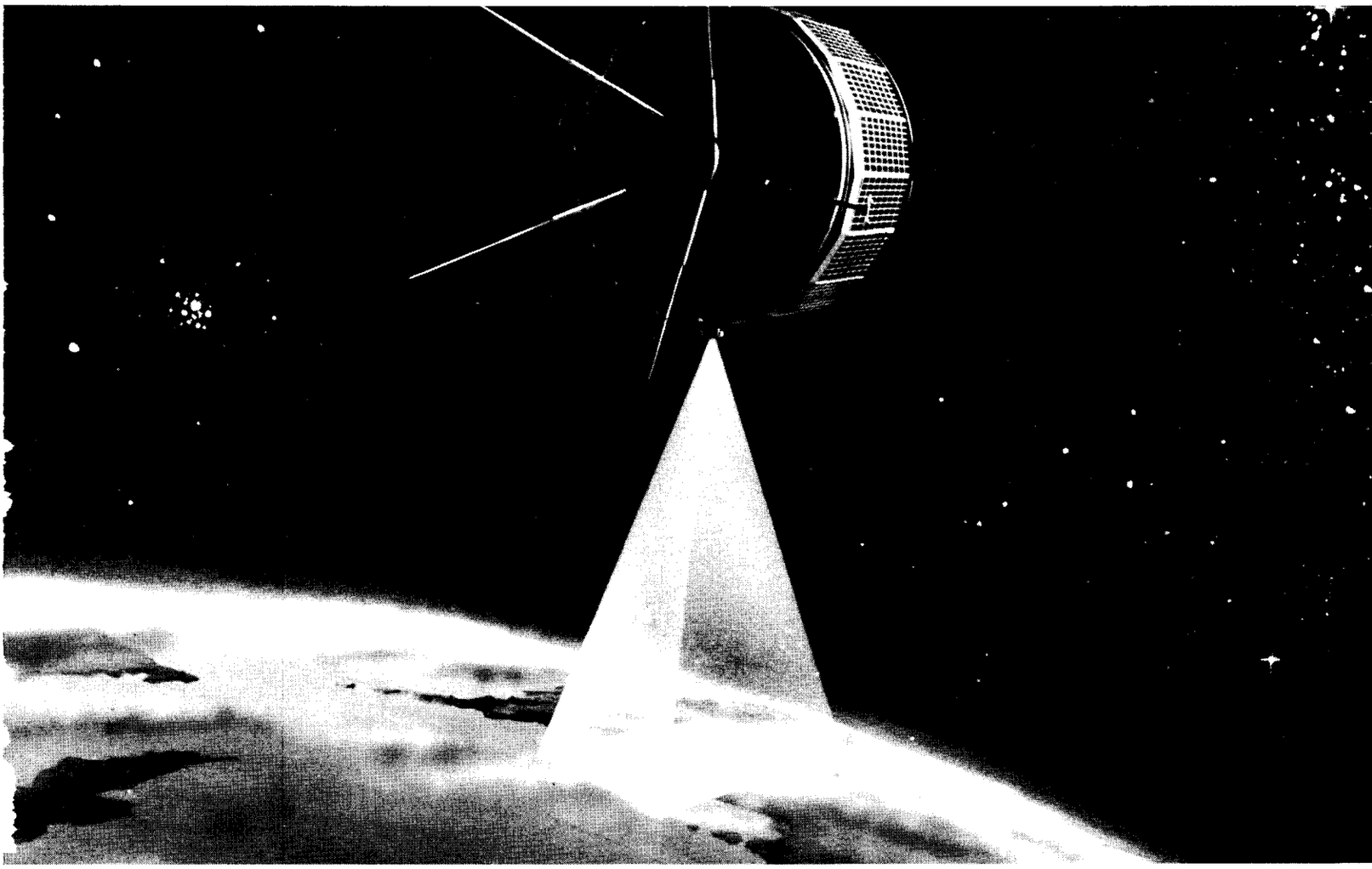


This artist's concept shows how cameras in the new "cartwheel" TIROS will photograph the earth as the satellite rolls along like a wheel in a near-polar orbit.

A New "Cartwheel" TIROS Weather Satellite

As the Goddard News went to press, Goddard launch crews, once again, were preparing a satellite for launch. (Why can't launch dates and Goddard News deadlines coincide—ever?) This week the first "cartwheel" TIROS weather satellite was being readied at Cape Kennedy. It will be the first "new generation" TIROS to photograph the entire sunlit portion of the world on a daily basis.

This new experimental satellite, a "cartwheel" version of the earlier TIROS models which have snapped some 394,000 pictures (as of November 1, 1964), gets its name from the way it will roll through space much like a wheel turns on a slow-moving automobile. Ideally, it rolls along at 10 revolutions per minute.

An attempt to place the satellite into a near-polar orbit will also mark another "first" in 14 years of space firings from Cape Kennedy.

Goddard's Robert M. Rados is project manager. The Delta launch vehicle is managed by Bill Schindler, the Center's Delta project manager. Goddard's Launch Operations (GLO), under the direction of Bob Gray, has launch responsibility.

If the launch attempt is successful the satellite, designated TIROS I (eye), will be called TIROS IX and will mark the 10th consecutive meteorological satellite orbit in 10 attempts by NASA. This includes eight straight for TIROS plus the Nimbus I weather observer.

About the only likeness between TIROS I and its eight predecessors is the hat-boxed shaped structure. It is a cylindrical 18-sided polygon which weighs 305 pounds, stands 22 inches high and measures 42 inches in diameter.

Although the shape of the cartwheel TIROS is similar to the earlier versions, the inside of the weather-eye contains several new electronic units.

Some of these new components to undergo testing for the first time aboard TIROS are: digital clocks, control system, horizon scanners, solid state commutators for telemetry, and a new triggering system for the cameras.

Even the 9,100 solar cells mounted on the top and sides of the satellite structure have been changed from positive on negative (P on N) to negative on positive (N on P). N on P cells do not deteriorate as rapidly as the satellite sweeps through the artificial radiation belt.

(Cont'd on p. 2)

New TIROS: Polar Orbit For Better Coverage

(Cont'd from p. 1)

The Delta launch vehicle, which has placed 24 NASA satellites in orbit, is programmed to put TIROS I into a circular orbit 460 statute miles high, inclined 81.6 degrees retrograde to the equator, with an orbital period of 100 minutes.

TIROS I's Objective

Primary objective of the TIROS I research and development launching is to test out the wheel configuration. The cartwheel storm observer is the forerunner for the joint NASA and U. S. Weather Bureau operational system called TIROS Operational Satellite (TOS) system).

The TOS program, consisting of six launchings, is scheduled to begin late in 1965.

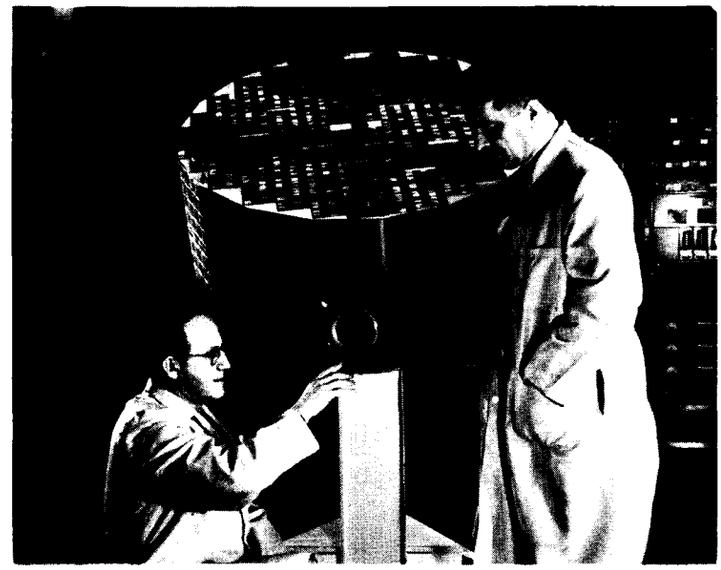
The TIROS I cartwheel spacecraft differs from the earlier TIROS in that the cameras view the earth from the side of the satellite rather than from the bottom. The cameras are placed on the rim of the satellite so they view the earth once during each revolution.

As TIROS I rolls through space, two ½-inch vidicon cameras can take pictures at 32-64 on 128-second intervals or more than 400 daily.

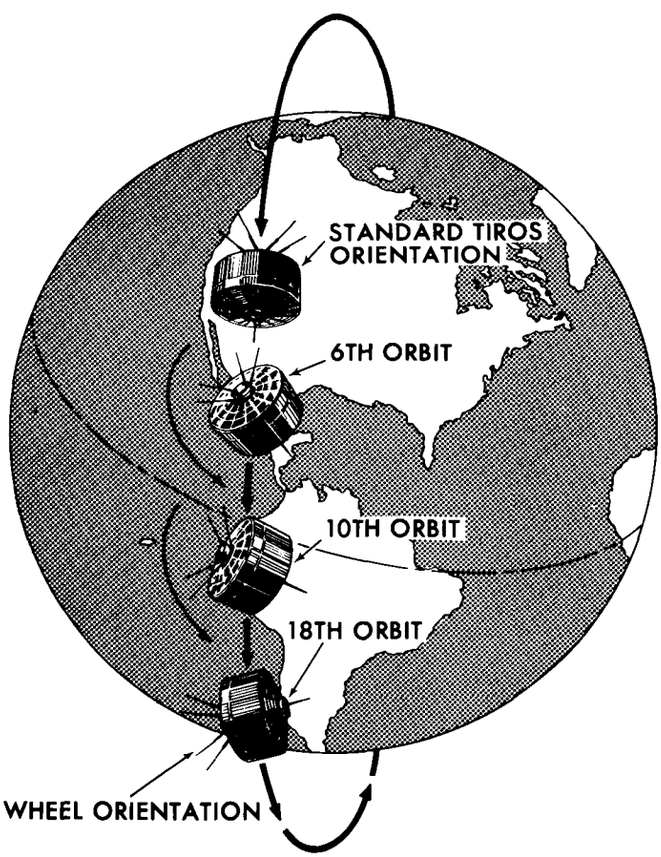
Pictures will be sent to TIROS ground stations on at least 10 of the 14 daily orbits. However, weather pictures can be recorded during three "blind" orbits (orbits which do not pass over one of the three TIROS ground stations) for playback on a later pass.

The Combination for Complete Coverage

Complete coverage of the world's cloud cover, compared to about 25 percent with earlier TIROS, will be possible due to a combination of the cartwheel configuration and an orbit which is polar and sun synchronous.



Project managers, Abraham Schnapf of the Radio Corporation of America (left) and Robert Rados of Goddard take a final inspection look at the new "cartwheel" TIROS weather satellite before shipment to Cape Kennedy, Florida.



Artist's sketch shows how the new "cartwheel" TIROS will turn on its side and roll through space like a slow-turning wheel so that satellite's two television cameras can snap pictures of the entire earth's cloud formations.

In a sun-synchronous orbit the precession of the satellite is about 1-degree daily, the same rate and direction as the earth moves around the sun.

Thus, the sun is always behind TIROS so the satellite is in a favorable position to take pictures during all four seasons of the year.

TIROS I will ride into orbit atop the 3-stage Delta on a 131 degrees heading from Cape Kennedy, Florida. The vehicle will head southeasterly from the Cape, will "dog leg" around Florida, will streak southerly through the Caribbean and head out over the Pacific Ocean.

The satellite is set for injection into orbit over the Pacific Ocean about 300 miles west of Quito, Ecuador.

Delta Performance for Proper Orbit

To attain the proper orbit, Delta will perform three dog leg maneuvers—during first and second stage burning, and during the coast period before third stage ignition.

During the first orbit the satellite will operate in much the same manner as the earlier TIROS spacecraft. It will be spin stabilized at about 10 rpm with the bottom of the spacecraft, or baseplate, looking at the earth.

As TIROS starts its second orbit a gradual orientation maneuver, performed by ground controllers, begins to turn the satellite on its side into the cartwheel position. On command from the ground, electrical currents pass through a magnetic attitude coil inside the spacecraft which turns the satellite on its side at a rate of approximately 10 degrees per orbit.

When the satellite is about half way on its side (45 degrees to the vertical plane of the earth) the current will be reduced to about half so TIROS will turn five degrees each orbit.

Approximately 14 orbits, or 24 hours after launching, TIROS I should be turned on its side in the cartwheel attitude and project engineers will turn the two television cameras on to photograph the earth.

Spacecraft performance data as well as weather pictures will be sent to three ground stations called Command and Data Acquisition (CDA) stations. These stations are at Wallops Island, Virginia, San Nicholas Island off the California coast, and Gilmore Creek, Alaska.

CAN DO!

A Photo Story of Goddard's Structural and Mechanical Applications Section

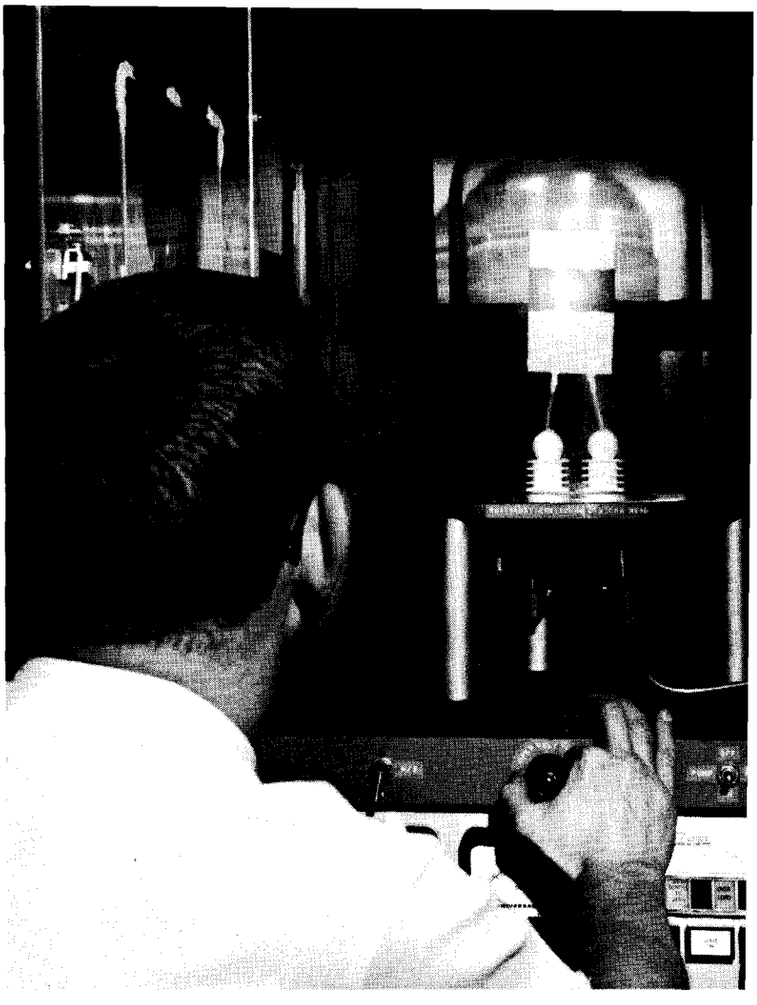
Scientific satellites and sounding rockets are complicated assemblies of hardware and electronic gear. They represent the plans and hopes of their "authors"—the engineers and scientists who have conceived their missions.

Goddard's Structural and Mechanical Applications Section is made up of highly skilled technicians who convert these plans into hardware. For this section provides the facilities, instrumentation, and services in the laboratory and in the field to support the Mechanical Systems Branch and Spacecraft Integration and Sounding Rocket Division. Here mechanical and structural designs are evaluated from the standpoint of operation, reliability and quality control. This section also provides laboratory instrumentation, equipment and services for advanced technical development programs.

Some of the techniques and capabilities available include: compound special raw rubber formulations and to mold the required parts from it, transfer and compression molding of various parts from thermosetting resins, and fiberglass wet layup. The components and parts made in the section are not usually available from any other source—they are frequently "one-of-a-kind" items. This makes it possible to have engineering prototypes and flight hardware, which are designed and built around the requirements of the components and parts. Listed below are a few examples of component and hardware built from plastics and rubber for different projects:

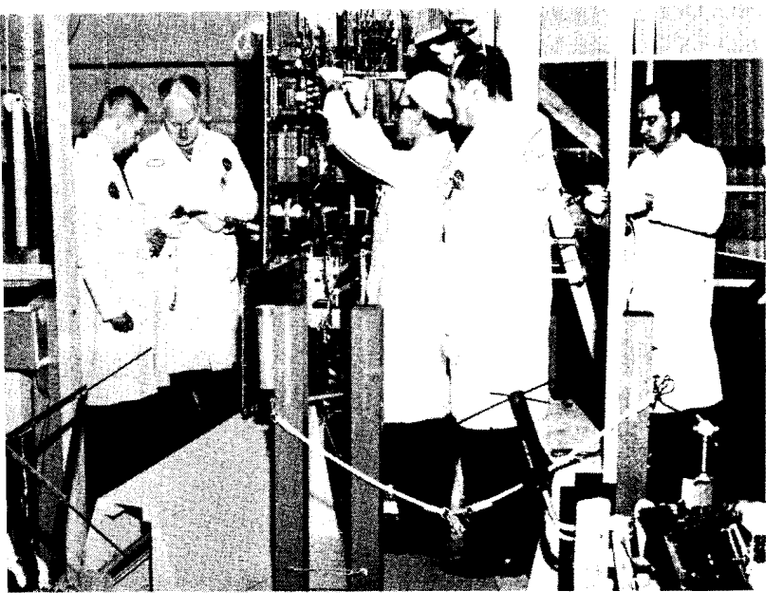
- (S-52) Capstan friction drive rollers molded from silicon rubber, compounded and transfer molded.
- (Airglow) Retainer tube seals compounded and molded from Viton "B" Rubber.
- Test cable connectors molded from silicon rubber.
- Shutter "O" Rings molded from Viton "B" Rubber.
- (IMP) Bias sphere 13 inch diameter .010 in thick wall weighing 4 oz. This is the magnetometer ball which was flown on IMP B. This was constructed from two layers of .003 inch fiberglass cloth and high temperature epoxy resin.
- Heat shield for the IMP D and E to protect the payload from the heat of the fourth stage rocket motor. Made from fiberglass cloth and high temperature epoxy resin.
- Designed the mold and transfer molded the fly-away connectors for the IMP D and E fourth stage motor break-away mechanism.
- The engineering model of a smaller piggy-back satellite was constructed from fiberglass honeycomb.
- (Aerobee) Tray seals for water tight protection, compounded and molded of silicon rubber.
- (EGO II) Shock mounts compounded and molded from silicon rubber.
- (OSO) Ultra violet spectrum gasket compounded and molded from Viton "B" rubber.
- (AE-B) Valve seats compounded and molded from Viton "A" rubber.

(See photos on pages 4 and 5)



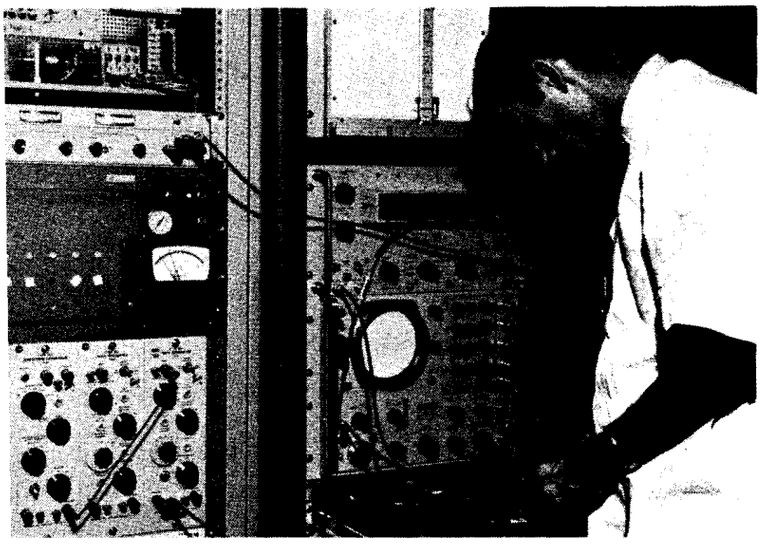
High voltage breakdown tests are being conducted by James Bush, associate section head, to find better methods of insulating and designing circuits that will have a capability of carrying up to 25,000 volts D.C. while at critical pressures of .5 to 3 torr.

Francis LeDoux, head of the Structural and Mechanical Applications Section, and James Bush, associate section head, discussing plans for future work.



From left, William Phillips, Walter Smith (Goddard), Robert Dallatore (WTA), Alfred Wolfson (Goddard) and Ken Gardner (WTA), conduct a preliminary inspection on the OGO-B structural model. The spacecraft will be inspected and determinations made on proper locations for connector mountings, cable tie-downs, instrument packages, and other mechanical devices.

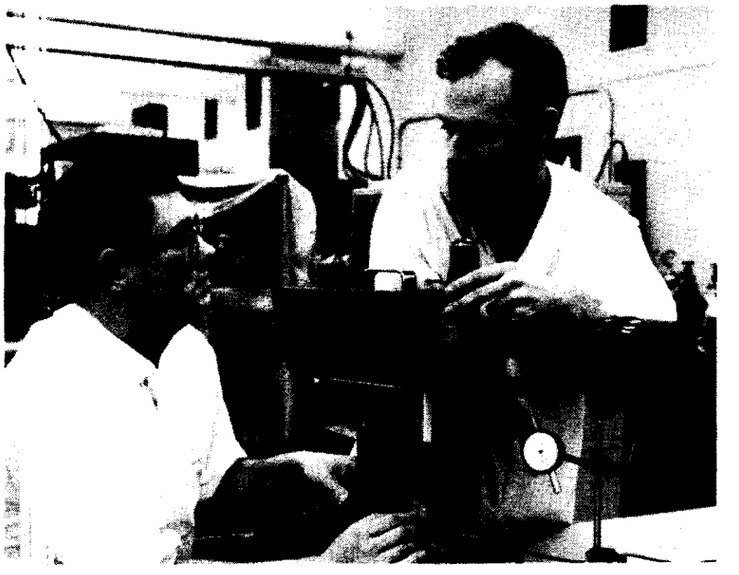
William Grenier (Goddard) examines a sample of the Bausch & Lomb Research Metallograph, the effective heart of a well equipped Metallographic Laboratory, prior to mounting to obtain photo micrograph. The instrument is capable of magnifications as high as 3000 diameters, under bright field, dark field, polarized light or sensitive tint. Microstructures of materials are analysed at high magnifications to determine such things as; grainsize, presence of cold work or deformation, segregation of microscopic particles, and distribution of alloying elements. Problems involving specific treatment and usage of materials can, in part, be determined from such an analysis.

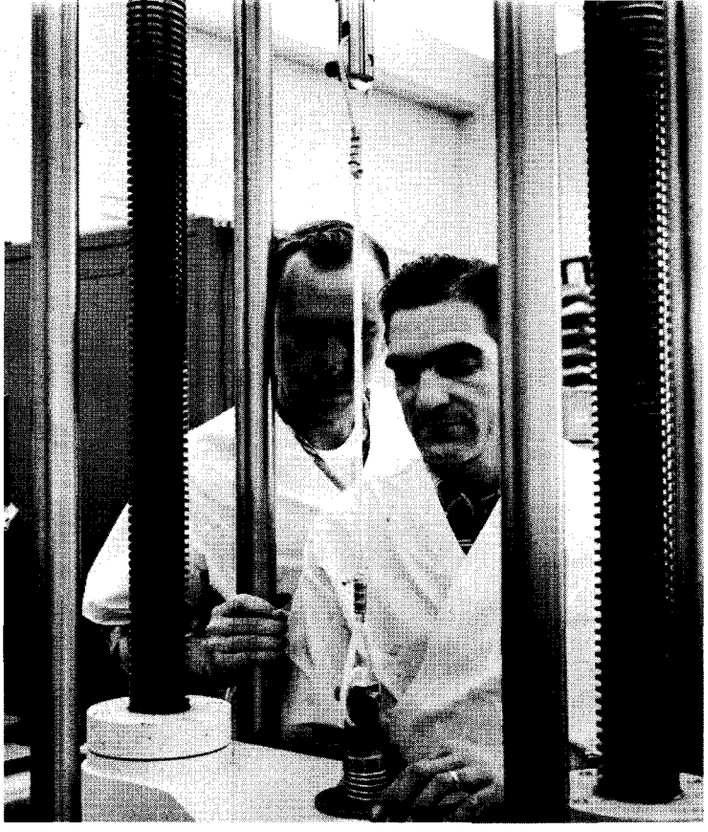


Robert Peterson (Goddard) working with the equipment used in the in-house development of the brushless D.C. motor. The brushless D.C. motor was developed for future use in spacecraft. It will be used for operating mechanisms such as the Mechanical Systems Branch in flight testor. The purpose of the D.C. motor is to eliminate electrical interference that may occur when using a drive system that uses brush contacts. ←

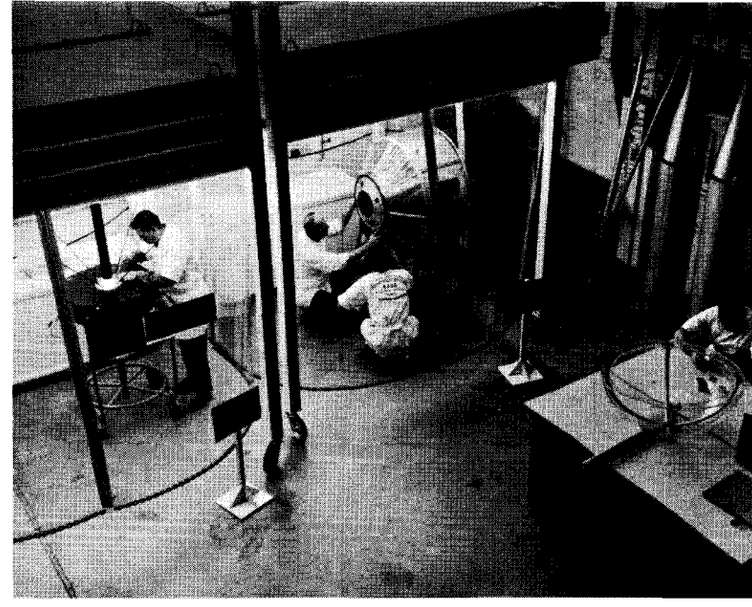
Goddard's Henry Kingwood is shown removing the strip coating from a magnetometer for the OGO-B spacecraft.

Goddard's Louis Noviscky and Grafton Cole (WTA), work with an engineering model of the stabilized platform for Ultra Violet Spectrograph. The servo system which consists of a single axis A.C. to D.C. servoloop was developed in the Mechanical Branch by the Advanced Technical Development and Structural and Mechanical Applications Sections.



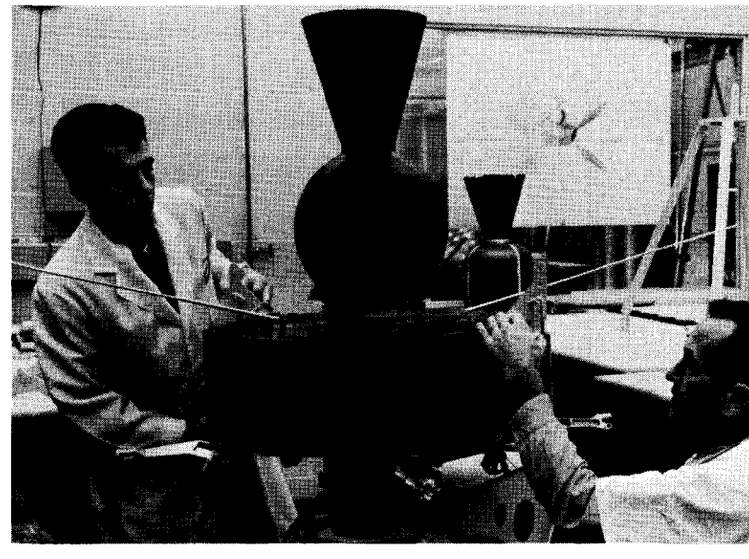


James Kauffman and John Sween (Goddard) conducting a test to determine the tensile strength of teflon coated fiberglass shielded nylon cord to be used as a tie-down for booms, polar paddles and other appendages. These particular tests are being conducted to determine strain characteristics of cords that will be used in the FR-1 spacecraft.

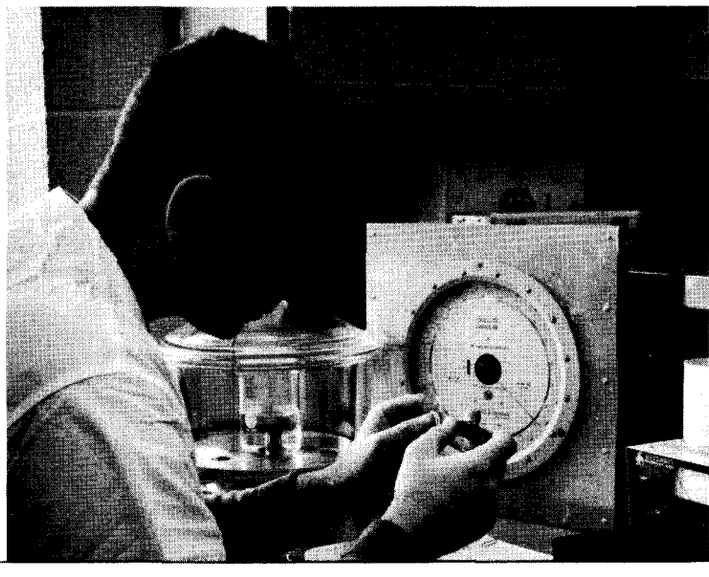


Donald Bower (Taag Design, Inc.), Raymond Berkley, Paul Henley (Goddard) and Bob Breeden (Taag Design, Inc.), shown in the Hi Bay assembly area in building 11. Mr. Bower is working on the EPE-D space unit in one clean booth while Mr. Berkley and Henley are working on the RAE mock-up in another clean booth.

Anthony Pierro and Paul Henley (Goddard) mount a fixture on the engineering test unit of the Interplanetary Explorer (IMP-D) that has just returned from a series of tests conducted in the centrifuge at the Naval Ordnance Laboratory. It is now being inspected for possible damage, and reassembly in preparation for conducting vibration tests. →

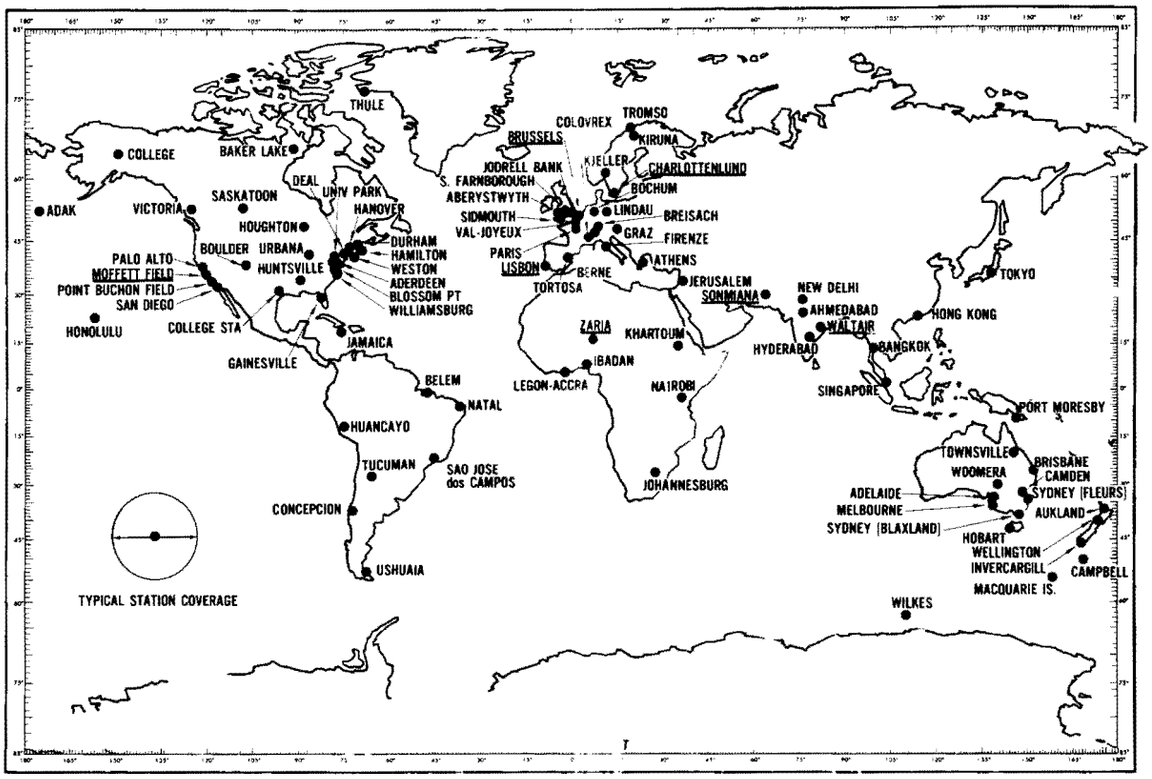


In the development of a spacecraft structure many small and intricate mechanisms and devices must be proven. Goddard's Fred Kocher shown working with the bellows assembly used for actuating the Fluxgate magnetometer on IMP-D is such an example. The bellows is filled with alcohol. When the alcohol is heated the expanding fluid provides a linear motion. This motion with gears, converts the linear motion to a rotational movement. This mechanism, when completed and accepted as flight hardware by the cognizant Mechanical Systems Branch project engineer, will be used to rotate Goddard magnetomer sensors on the forthcoming IMP D and E spacecraft.



Goddard's Louis Paul and Wilfred Zimmerman (Wells Industries), cutting and fitting thermal blankets for the Orbiting Plane Experiment Packages, (OPEP-2) for OGO-C.

BEACON EXPLORER SATELLITE MONITORING STATIONS



Addition of seven new stations in the world-wide Explorer XXII scientific network has been announced by Robert E. Bourdeau, Project Scientist for the Beacon Explorer program. This brings to 86 the total number of stations in the program—the most extensive scientific space program ever undertaken. The new stations, underlined on the map, are located at Brussels, Belgium; Charlottenlund, Denmark; Waltair, India; Sonmiani, Pakistan; Lisbon, Portugal; Moffett Field, California and Zaria, Nigeria. The 116-pound Beacon Explorer satellite, officially called Explorer XXII, was launched October 9, last year. Its mission is to make a comprehensive survey of the earth's ionosphere by transmiting data directly to ground stations costing less than $5,000. The stations are operated by scientists who are participating in the program on a voluntary basis. Project manager for the Beacon Explorer program is Frank T. Martin.

RELAY II IS ONE YEAR OLD

Launched:	January 21, 1964
Apogee:	4,600 statute miles
Perigee:	1,200 statute miles
Period:	195 minutes
Inclination:	46.3°
Orbits completed in first year:	2,702
Miles traveled:	115,701,000
"On" transponders:	360 hours
	610 different operations
Experiments:	1,725
Demonstrations:	117

Historical Milestones

- 1964 Summer Olympic Games
- Republican and Democratic National Conventions
- New York World's Fair Opening
- Sonny Liston—Cassius Clay Championship Fight
- President Charles DeGaulle's Trip to Mexico
- United States and United Kingdom Elections
- President Lyndon B. Johnson's Thanksgiving Day Message
- Inaugural Messages of New Station in Grinon, Spain
- Inaugural Messages of New Station in Kokusai Denshin Demwa
- Inaugural Messages of New Station in Juo-Machi, Japan

Impetus

Editor's Note: This column of thoughts from various quotable sources will run whenever ideas are available which fit this definition—"comments which give impetus to the creative mind; which stretch and exercise the intellect." Publication does not necessarily imply endorsement.

"Those who have telescopes know how difficult it is to find a star or planet at times, especially when using high power. You may see the object plainly, point the telescope at it and then hunt for five or ten minutes before finding it.

"The Mariner IV is on its way to Mars to take pictures, and when it was about twice the distance of the moon they moved it around so as to set it on Canopus, the second brightest star in the sky. It is in the South, and not visible here. But they aimed the rocket half a million miles away and got it set on that star.

"Since that time it lost Canopus, but adjustments have been made on the Mariner, now much farther away, and it is believed that they now have it on the proper path to come quite close to Mars, in July, take pictures and send them back to earth. It will send the pictures back from a distance of more than 40,000,000 miles.

"That is what scientists can do, and it is just about beyond belief. At times they are now sending balloons to a height of 90,000 or 100,000 feet, carrying quite a large telescope, which is aimed at any object desired, with pictures taken and returned to earth. At that height there is practically no atmosphere and so excellent pictures can be taken.

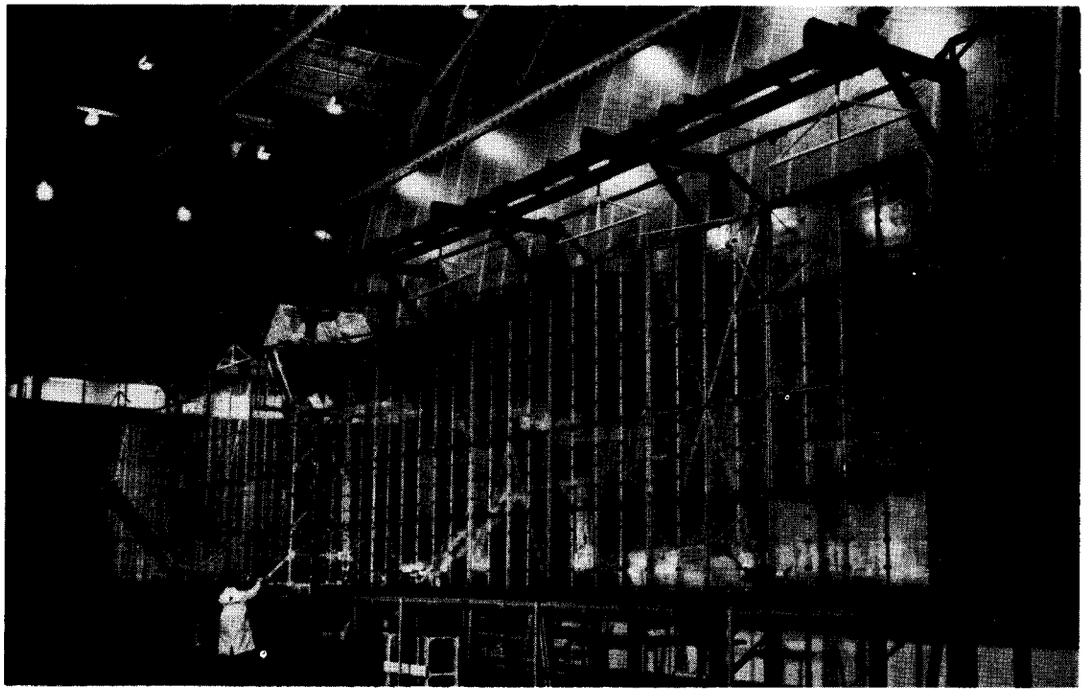
"At one time in this country there was a tendency to ridicule and sneer at highbrows, intellectuals, but let it be known that the men who are sending rockets to take pictures of the moon, Mars and Venus are intellectuals far beyond comprehension of the average person. They are about the most important 'people in the country—in the entire world."—editorial in The Bryan Times.

Goddard Will Track Pegasus For 18 Months

Early this year a Saturn I space vehicle (SA-9) will launch the first of three giant satellites called Pegasus into an earth orbit ranging from about 310 to 465 miles altitude.

The Pegasus mission will require extensive ground tracking and data acquisition support. To meet this requirement, Goddard's Manned Space Flight Tracking Network (MSFN) along with certain elements of the Department of Defense Gulf and Eastern Test Ranges will initially support the SA-9 vehicle through its first five orbits, after which Goddard's Space Tracking and Data Acquisition Network (STADAN) will assume responsibility for monitoring and tracking the satellite for the full 18-month lifetime of the 136-mc telemetry transmitters.

The satellite will be visible from Earth. The primary mission of the Pegasus satellites is to measure, record and transmit back to Earth data on the frequency, size, direction and speed of meteoroids in near-Earth space. This information is important to the development of the manned and unmanned spacecraft.

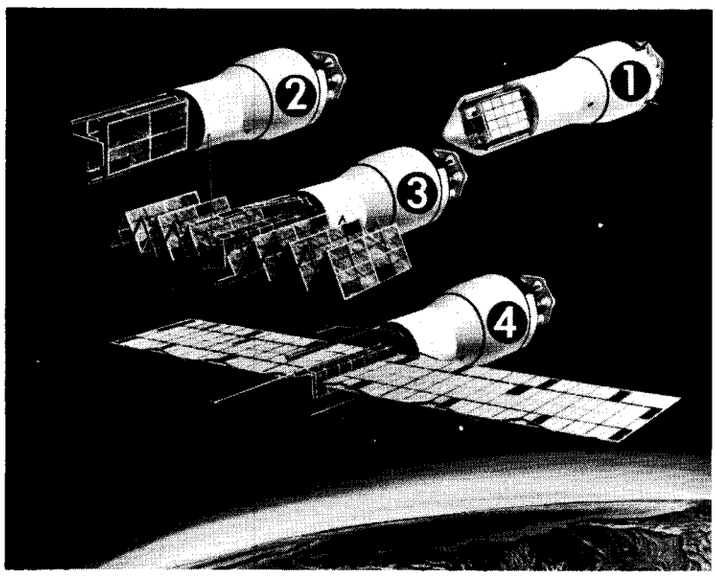


These giant panels will be tucked into a Meteoroid Detection Satellite. After the satellite is launched by a Saturn rocket, the panels will unfold in space to form a wing 96-feet long and 15-feet wide. Electronic detectors in this broad wing expanse will determine size and frequency of meteoroids, gaining information to help in designing spacecraft which will be exposed to the space environment for long periods.

Recent Technical Publications Authored by Goddard Staff

B. E. Shute, "Prelaunch Analysis of High Eccentricity Orbits," NASA Technical Note D-2530, December 1964.

Satya P. Talwar, "Hydromagnetic Stability of Stellar Atmospheres," NASA Technical Note D-2218, January 1965.



This drawing shows meteoroid detection panels being deployed (1) on a Saturn-launched satellite, in the folded position aboard the launch vehicle (2), unfolding (3). The satellite's 96-foot wing-like structure unfolded (4). The presence of tiny particles in space will be recorded as they collide with the wing skin sensor.

Goddard Speech and Paper Presentations

(Technical presentations approved as of January 15, 1965, for period of January 25 through February 7, 1965. Requests for copies of speeches and papers should be made directly to the author.)

I. O. Bohachevsky and R. E. Mates, 2nd AIAA Aerospace Sciences Meeting, January 25-27, New York, New York, ***"A Direct Method for Computation of Asymmetric Blunt Body Flows."***

Cuddapah Prabhakara, American Meteorological Society, January 25-28, New York, New York, ***"Equilibrium Temperature Distribution in the Mesosphere and Lower Thermosphere."***

Dr. P. H. Fang and W. Gdula, American Physical Society Annual Meeting, January 27-30, New York, New York, ***"Anisotropy of Defect Formation."***

M. M. Sokolosky and Dr. P. H. Fang, American Physical Society Annual Meeting, January 27-30, New York, New York, ***"Dielectric Constant of PbTe."***

A. K. Bhatia and A. Temkin, American Physical Society, January 27-30, New York, New York, ***"Decomposition of the Schrodinger Equation for Three-Body Problem."***

L. A. Schmid, American Physical Society, January 27-30, New York, New York, ***"Relativistic Isentropic Flow of Electron Gas."***

M. Liwshitz and S. Singer, American Physical Society, January 27-30, New York, New York, ***"The Distribution of Neutral Hydrogen in the Earth's Thermosphere."***

A. G. W. Cameron, American Physical Society, January 27-30, New York, New York, ***"Effects of the Symmetry Energy in Atomic Mass."***

A. G. W. Cameron and A. Gilbert, American Physical Society, January 27-30, New York, New York, ***"A General Formula for Nuclear Level Densities."***

Carl E. Fichtel, Space Science Seminar, Rice University, February 4, Houston, Texas, ***"Solar Particle Events."***

Dr. Isidore Adler, X-ray Seminar, Stevens Institute of Technology, February 4-5, Hoboken, New Jersey, ***"Pulse Height Analysis."***

Dr. John O'Keefe, Ceramic Society, February 5, Corning, New York, ***"View of the Moon Through Glass Technology."***

Robert Jastrow, College of the Virgin Islands, January 25, St. Thomas, Virgin Islands, Lecture Course.

Albert Arking, American Meteorological Society, January 26, New York, New York, ***"Global Distribution of Earth Albedo and Cloud Cover."***

Ishtiag S. Rasool, American Meteorology Society, January 28, New York, New York, ***"Radiation Studies from Meteorological Satellites."***

Robert Jastrow, Livittown students, February 6, New York, New York, lecture course.

Sounding Rockets To Be Launched From Alaska

This month the United States will take another step to extend its exploration of space with the launching of the first scientific sounding rocket from Point Barrow, Alaska.

This will also be the beginning of a series of acoustic grenade experiments to collect upper atmospheric meteorological data within the Arctic Circle.

Point Barrow, 1,100 miles from the North Pole and 300 miles within the Arctic Circle at 71 degrees North Latitude, will serve as a base for sounding rocket exploration and measurement at altitudes of 30 to 100 kilometers (19 to 65 statute miles)—using two-stage Nike-Cajun rockets.

Wind direction and velocity, atmospheric temperature, density and pressure are obtained from grenade experiments. This is accomplished by ejecting and detonating 12 acoustical grenades along the trajectory of the rocket, accurately locating in space the position of each explosion, and measuring the time arrival and direction of the sound waves on an array of sensitive microphones on the ground.

The experiments will be continued on a quarterly basis with two or three each quarter. They will be coordinated with similar experiments being fired at the Fort Churchill site in Canada and Wallops Station, to obtain nearly simultaneous measurements from different geographic areas during the various seasons.

The Alaskan effort is an extension of NASA's Meteorological Sounding Rocket Program to explore and understand the structure and behavior of the atmosphere on a global basis. The program is conducted by Goddard, under the overall direction of the Office of Meteorological Programs, NASA Headquarters.

Wallops Station is responsible for technical support and operations at the Point Barrow site with the technical guidance and financial assistance of the NASA Office of Tracking and Data Acquisition.

Goddard's Wendell Smith is project scientist for the meteorological experiments. Technical supervision of facilities modifications is under the direction of Robert L. Brashears, head of the Experimental Facilities Branch at Wallops Station.

The Point Barrow operations will be directed by a Wallops Station team headed by William L. Lord of the Program Management and Liaison Branch.

Modification of existing facilities was directed by Max Brewer, director of the Arctic Research Laboratory at Point Barrow. The laboratory is operated by the University of Alaska under contract with the Office of Naval Research (ONR). Dr. Max Britton directs the polar research activities of ONR.

GT-3 Arrives At Cape

The Gemini spacecraft, in which Astronauts Virgil (Gus) Grissom and John Young will make the nation's first two-man flight this spring, arrived at the Kennedy Space Center early this month.

The spacecraft, designated GT–3 was moved from McDonnel Aircraft Corporation at St. Louis to the Center for final flight preparations. Traveling via an Air Force C–124 transport, GT–3 arrived at the skid strip on Cape Kennedy and from there was moved by special transporter to the Pyrotechnic Installation Building on Merritt Island.

Three orbits are planned for the first manned Gemini flight to be launched from Cape Kennedy.

Objectives of the mission are to evaluate spacecraft systems, astronaut procedures, and the world wide tracking network with respect to the spacecraft.

The astronauts also will conduct three experiments: Evaluate effects of zero gravity on sea urchin eggs, measure aberrations in human blood cells which have been exposed to radiation during weightlessness, and determine the effect of a coolant on the so-called ionization sheath which "blacks out" communications during reentry.

OSO-B2 Ready For Launch

Checkout tests of the OSO–B2 satellite with the Delta rocket third stage were completed last week at Goddard Launch Operations, Cape Kennedy. OSO–B2, built mainly of parts salvaged from the OSO–B satellite damaged in an accident last April, is scheduled for launch by Goddard no earlier than February 2 to continue the pioneering solar investigations of the highly successful OSO I. The orbit for the new 545-pound observatory-class satellite will be 350 miles above the earth. Goddard project manager for OSO is Laurence T. Hogarth. Project scientist is Dr. John C. Lindsay.

GODDARD NEWS

JANUARY 25, 1965

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

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Jerry Stark, *Editor* Shirley Deremer, *Inside Goddard*

Photography by Goddard's photographic branch

* *Press date precedes publication date by approximately seven days.*