GODDARD NEWS

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GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

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Pope Sees Moon Pictures

Gilbert Ousley, former Assistant for International Programs at Goddard, and now the NASA European Representative stationed in Paris, accompanied Dr. Robert Seamans, NASA Associate Administrator, on a mission to satisfy a request by Pope Paul VI to see the photographs made by the Ranger Spacecraft as it neared the moon. The special showing was very informal and lasted approximately twenty minutes. Dr. Seamans (right) and Mr. Ousley (left) were very impressed with the Pontiff's personal warmth and they noted a keen interest on his part concerning NASA's international programs.

OSO-B2 Will Scan The Entire Solar Surface

The launch from Cape Kennedy on February third, climaxed a nine-month effort to make ready the 545-pound Orbiting Solar Observatory (OSO) for its flight.

The spacecraft included parts salvaged from the OSO-B damaged last April in a pre-launch mishap and from components of a spacecraft built for prototype testing.

This spacecraft carried the same scientific payload as the OSO-B, it is designated OSO-B2.

OSO I, the first satellite devoted exclusively to the study of the Sun, was launched March 7, 1962. OSO-B, although physically similar to OSO I, carries experiments capable of conducting more extensive scientific investigations.

OSO-B was to have been launched in April 1964. However, on April 14, during prelaunch checkout at the Spin Test Facility at Cape Kennedy, the satellite was seriously damaged when the X-248 third stage rocket to which it was mated inadvertently ignited.

Many components and six of the eight experiments on the spacecraft were salvaged and along with parts of the OSO prototype, backup parts of the OSO-B and some newly-built parts were assembled into a new spacecraft.

OSO-B2 was launched by a three-stage Delta rocket into a circular orbit at 350 miles altitude and inclined 33 degrees to the equator. It takes about 97 minutes to complete an orbit.

The eight experiments carried on board accounts for 215 pounds of the 545-pound total. This continues the precedent of high ratio of experiment weight to total spacecraft weight set by OSO I.

The satellite has two main sections. The spinning base portion, called the wheel, provides gyroscopic stability and houses the telemetry, command, batteries, control electronics and gas spin-control arms and five experiment packages. The top section called the sail, is fan-shaped and will point toward the Sun when visible. The sail contains the two primary solar pointing experiment packages (containing three experiments) and solar cells to convert solar energy into electrical power.

For the first time, the instruments, controlled by ground command, will scan the entire solar surface, requiring four minutes to complete each scan. This technique is known as the raster scan mode of operation.

In addition to the scanning capability, OSO-B2 carried a new digital telemetry system to increase data capacity and resolution; a new command system capable of receiving 70 commands as opposed to eight for OSO I; and, finally, a redesigned and improved tape recorder.

The eight advanced experiments carried by OSO-B2 are designed to further the work of OSO I; study X-rays, gamma rays and ultraviolet radiation. They represent a joint government-university-industry effort.

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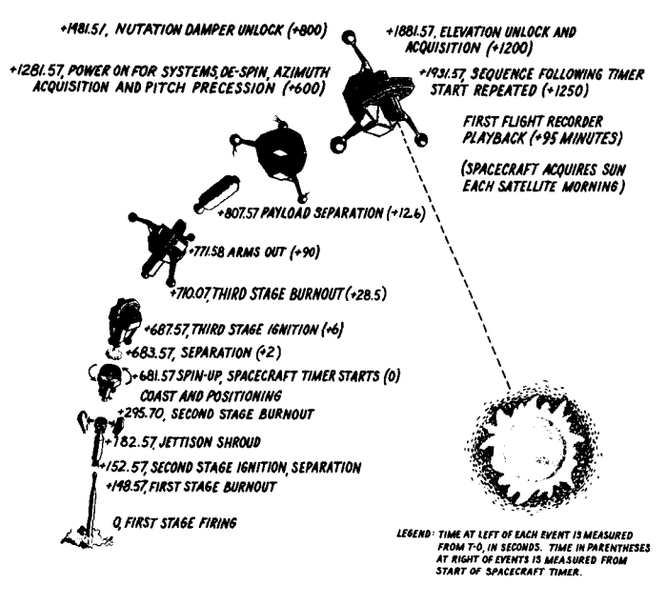
OSO-B2 Flight Sequence



KEY MEMBERS OF GODDARD'S OSO-B2 TEAM

Laurence T. Hogarth
OSO Project Manager

Dr. John C. Lindsay
OSO Project Scientist

Thomas E. Ryan
Tracking and Data Systems Manager

William R. Schindler
Delta Project Manager

Robert H. Gray
Manager, Goddard Launch Operations

(Cont'd from p. 1)

EXPERIMENTS

The two experiment packages carried in the sail section which will scan the Sun include:

- Ultraviolet spectrometer — Spectroheliograph (Harvard University).
- Solar X-ray and ultraviolet imaging experiment (Naval Research Laboratory).
- White light coronagraph (Naval Research Laboratory).

The latter two experiments are in a single package.

The five wheel-mounted experiments are:

- Zodiacal light device to monitor polarized light in interplanetary space (University of Minnesota).
- High energy gamma ray measuring device for measurement of primary cosmic gamma rays (University of New Mexico).
- Low energy gamma ray measuring device for detection and analysis of the energy spectrum of gamma rays (Goddard).
- Astronomical ultraviolet spectrophotometer (Goddard).
- Emmissivity stability measurements of thermal-radiation characteristics of the satellite's surface to determine stability of satellite temperature-control coatings (Ames Research Center).

The OSO program is directed by the Physics and Astronomy Programs Division of the Office of Space Science & Applications at NASA Headquarters. Goddard is responsible for project management, tracking and data acquisition and the Delta launch vehicle.

OSO satellites are built under Goddard contract by Ball Brothers Research Corporation, Boulder, Colorado. The three-stage Delta rocket used to launch OSO is produced by Douglas Aircraft Company, Santa Monica, California.

Eight OSO satellites have been planned. The first of these, OSO-I, was launched in March 1962. It provided data on more than 75 solar flares and monitored the Sun's ultaviolet brightness and X-ray emissions for many months.

The sun is a turbulent mass of gases burning with an intensity far greater than a blast furnace. By astronomical standards it is a relatively small star among the estimated one-hundred billion stars that make up our galaxy—one of the hundred million galaxies in the cosmos.

As the star closest to earth, it is of great scientific interest. The next closest star would be ten miles away if the sun were the size of a pinhead.

The sun is so immense that if the earth were placed at its center, the moon would be located slightly over half-way to its outer edge. Ninety-three million miles—one astronomical unit—separate earth from the sun. Sunshine must travel eight minutes at the speed of light to reach us.

Goddard Speech and Paper Presentations

(Technical presentations approved as of February 1, 1965, for period of February 8 through February 21. Requests for copies of speeches and papers should be made directly to the author.)

Patrick Thaddeus, Unmanned Exploration of the Solar System Symposium, Denver, Colorado, February 8, 1965, ***"Atmosphere of Venus."***

Roger A. Cliff, American Astronautical Society, Denver, Colorado, February 8-10, 1965, ***"Logarithmic Compression of Spacecraft Data."***

A. L. Franta and ***D. A. Krueger***, American Astronautical Society Symposium on Unmanned Exploration of the Solar System, Denver, Colorado, February 8-10, 1965, ***"The Electronic Checkout and Integration of Orbiting Geophysical Observatory Experiment."***

Paul G. Marcotte, American Astronautical Society Symposium on Unmanned Exploration of the Solar System, Denver, Colorado, February 8-10, 1965, ***"Anchored IMP (AIMP) Mission and Spacecraft."***

A. G. W. Cameron, New Haven, Connecticut, February 10, 1965, astronomy colloquium.

A. G. W. Cameron, Yale University, New Haven, Connecticut, February 11-16, 1965, physics colloquium.

Robert Jastrow, Levittown Students, New York, New York, February 13, 1965, lecture course.

A. G. W. Cameron, Wesleyan University, Middletown, Connecticut, February 17, 1965, no title as yet.

A. G. W. Cameron, Union Junior College, Cranford, New Jersey, February 19, 1965, ***"Extraterrestrial Life."***

Robert Jastrow, Levittown Students, New York, New York, February 20, 1965, lecture course.

Cartwheel TIROS Makes Debut

One of America's most spectacular space stars made its debut shortly before dawn January 22, and captured top reviews from the scientists who spent months getting the starlet ready for the opening curtain.

The second curtain call took awhile in coming for the newest of the talented TIROS family due to slight over performance from another space star, the sleek, white Delta launch vehicle.

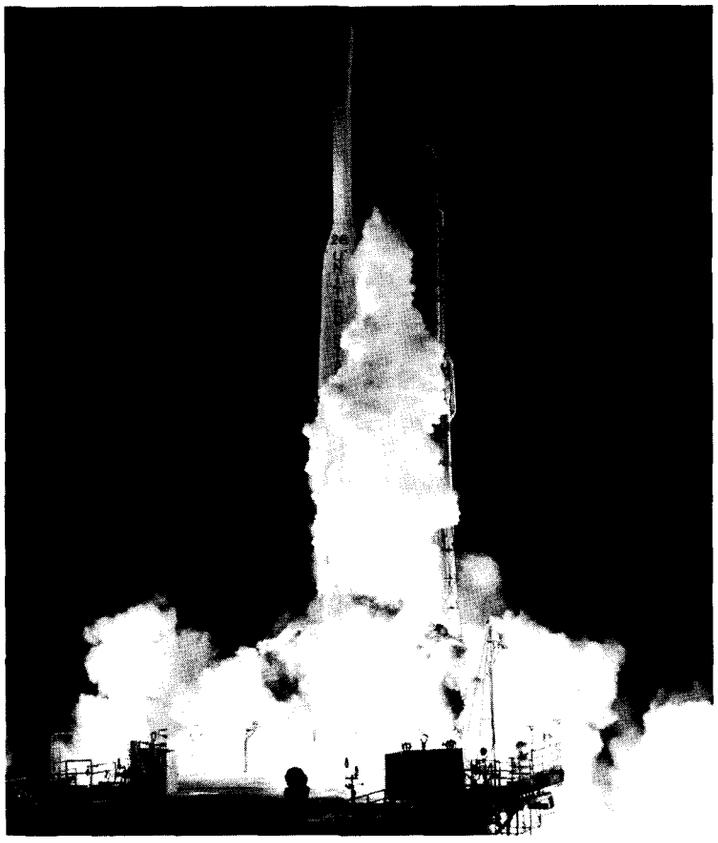
The camera-snapping TIROS IX weather satellite left Cape Kennedy atop the three-stage Delta which lit up the Florida coast like a giant light bulb at 2:52 in the morning.

Unlike the maiden flight of the "cartwheel" TIROS riding above, this was not Delta's first performance. On 27 occasions the 90-foot-tall vehicle had been called on for similar missions. The veteran space booster achieved orbit 25 times, an enviable record for any performer.

Delta's script for this mission was one of its toughest in four years of space flights. It called for three precise "dog leg" maneuvers to attain a near-polar orbit—the first in 14 years of firing from this space port.

Except for a long burn in the second stage, the flight was as planned and early tracking information indicated that the hat-box shaped TIROS was injected into orbit over the Pacific Ocean about 300 miles west of Quito, Ecuador.

Even so, project officials withheld their applause for a couple of hours because the 85-foot diameter electronic ear at Gilmore Creek, Alaska, still hadn't heard the beacon signal to confirm orbit.



TIROS IX LAUNCHED

The Antarctic Continent is photographed by the TIROS IX weather satellite from an altitude of 1,100 statute miles on the storm tracking satellite's 22nd orbit (Saturday evening, EDT, January 23, 1965). The Ross Ice Shelf and Little America can be seen in the center of the photo extending to the extreme right, while Victoria Land Antarctica appears left of center. This photograph was received at NASA's tracking station in Gilmore Creek, Alaska.

TIROS personnel weren't too concerned because they knew the delay was due to a hot burn in the launch vehicle which nudged the satellite a little further out in space. It's like a track star trying to run the quarter mile race around a half-mile track. It takes longer.

At 4:39 in the morning the voice of the new storm tracker came in loud and clear at Gilmore Creek. The mechanical meteorologist was in orbit. Its name was TIROS IX and it was the first of the TIROS family capable of photographing the entire sun-lit portion of the earth every day.

The 305-pound weather-station-in-space was circling the globe every two hours at a distance ranging from 435 miles out to 1602 miles.

The higher orbit didn't seem to bother the weather observer because the critics who developed the new star began a rigid check out procedure.

On its first orbit an electrical signal beamed skyward from San Nicholas Island off the California coastline to TIROS IX passing overhead. This was the first of many steps to turn the satellite on its side into the cartwheel attitude so it would roll through space like a wheel. This enabled the cameras to look at the earth every six seconds.

By the 16th orbit the wheel attitude had been almost achieved and project officials felt the bird checked out so the cameras could be turned on to photograph the world below.

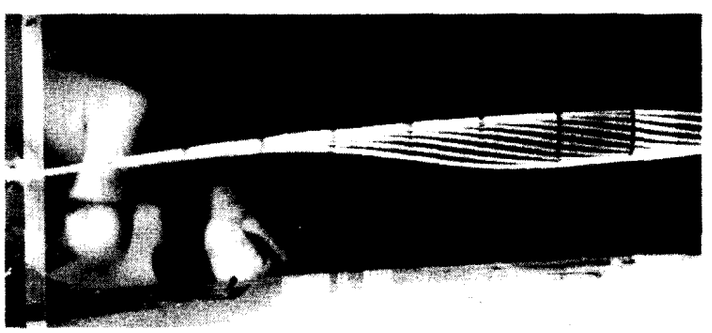
As the weather platform sped north on its 17th orbit, the first pictures were taken and relayed to NASA's Wallops Island, Virginia, station. It looked like the new weather eye was going to work as well as its eight predecessors which have taken more than 415,000 pictures since the first TIROS launching in April of 1960.

"Although the higher orbit has reduced the picture resolution," said Robert Rados, TIROS Project Manager, "it has not hampered meteorologists in the use of pictures for weather analyses." On the satellite's second day in orbit it photographed a snow storm in the western United States and continued to photograph it as it moved across the midwest headed for the eastern shore.

Because of its high orbit each TIROS IX photo covers an area of one-tenth of the

(Con't on Page 8)

This is an array of high speed 16 mm cameras, capable of taking from 200 to 10,000 photographs per second. Keith Walters (rear), adjusts the controls of an intervalometer used in time lapse photography. Bill Smith holds a 400' capacity camera specially designed for use in a vacuum.



Here, ten separate high speed flashes record a vibrating string at a cyclic rate of 10,000 cycles per second. ←

This Schlieren photograph shows the shock wave from an exploding wire. Exposure, using an image intensification system, is 10 one billionths of a second. (Bottom left)

At a speed of 800,000 pictures per second a shock wave is recorded as it progresses through a plastic block. (Left to right) ↓

Photo Instrumentation Aids Goddard Technology

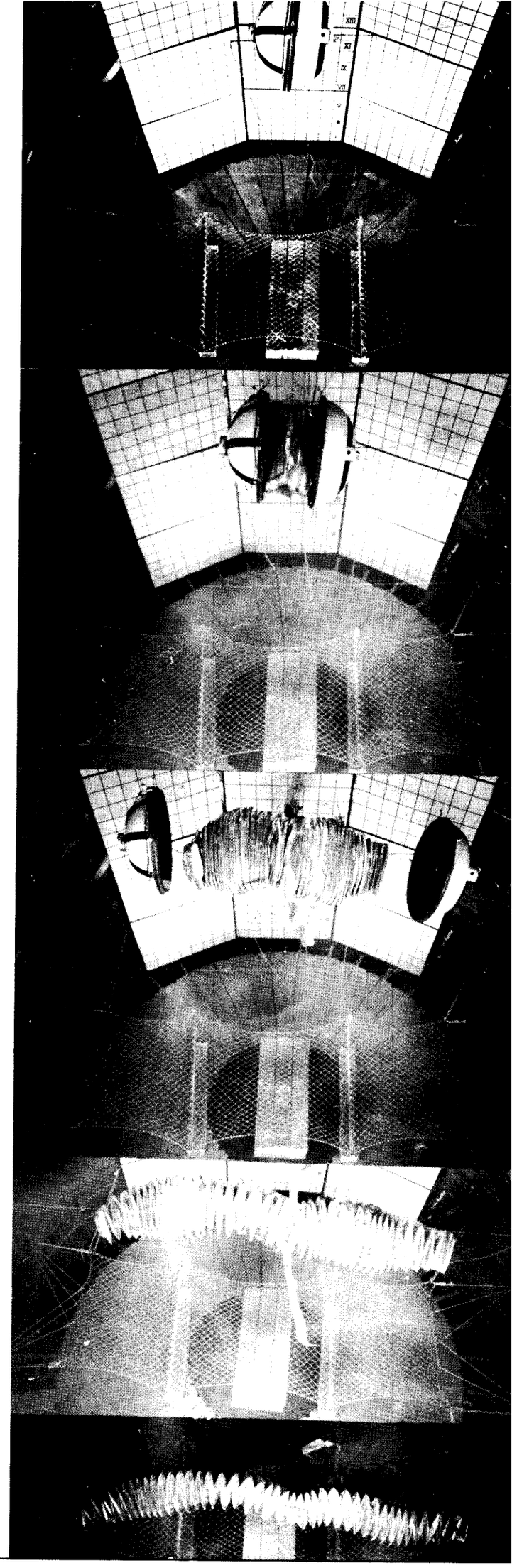
Goddard's Photographic Branch has long been noted for being "fast operators"—taking a photograph on five minutes notice or even furnishing a critically needed picture that was "due yesterday." Now, comes a new capability.

The branch has an assortment of 16 mm photo instrumentation cameras so fast that they could photograph a cobra's strike or stop the path of a bullet in flight. However, they are not being used for these purposes. Rather, these motion picture cameras are getting extensive use in photographing high-speed tests of projects where engineers and scientists must look beyond the capability of the human eye to observe deployment of booms on spacecraft, firing of explosive bolts, and other dynamic tests.

The cameras can take up to 10,000 frames per second in comparison to 16 and 24 frames per second by conventional "cine mode" cameras. What's more they can handle up to a 1,200 foot load of 16 mm film. Goddard engineers agree with the Chinese proverb—a picture is worth a thousand words—even in the space age!

Echo II cannister is being tested in a vacuum. The cannister halves are separated by a explosive charge which produces a slight haze. →

Camera pressure boxes mounted on a pole for a sounding rocket nose cone deployment test. Pressure boxes are used to shield photographic film and camera motors from the otherwise harmful effects of vacuum.



First Contemporary Order of Gemineer Awards Presented

Edward K. Foster (left), Vice President, Bendix Corporation, presents honorary pins and scrolls to Goddard key personnel. From left, Ozrow M. Covington, John T. Mengel and Niles R. Heller.

Dr. Harry J. Goett (right) Goddard's Director, receives his scroll from Edward K. Foster.

Recently, Dr. Harry J. Goett, John T. Mengel, Niles R. Heller and Ozro M. Covington were appointed honorary members in the Contemporary Order of Gemineers. They were presented the first tie tack-lapel pins and official scrolls of the order in brief ceremonies conducted in the Director's office. Later, Bendix personnel of the Manned Space Flight Tracking Network will receive identical pins and scrolls in recognition of their performance in support of manned space flight. All graduates of the NASA Electronics Training Facility, Wallops Station, Va., and accredited members of the press who visit foreign tracking sites will also be given the coveted awards. The Gemineer insignia is a cleverly designed gold-on-black "G" figure with a golden bit stream piercing the world. Beautifully finished, the tie tack-lapel pin is already the envy of all who have seen them. The handsome scroll with its original wording proves to be a worthy symbol of program participation.

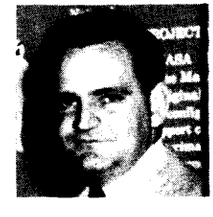
Mr. Foster (second from right) shown being pinned by Dr. Goett with the honorary Gemineer emblem. Looking on from left are, Leister F. Graffis, Murray Weingarten and Douglas M. Heller.

Wallops Graduating Class . . .

Front row, from left: Rice E. Harty (Kano), James F. McCool (Hawaii), John L. Hittell (Wallops), John E. Osborne (Wallops), Larry D. Hazelbaker (Canary), Charles B. Walker (Goddard) and Douglas H. Baker (Wallops). Back row, from left: Richard A. Lavoie (Kano), Robert G. Leighton (Wallops), Joseph E. Bryant (Wallops), Harold A. Dove (Tananarive), Thomas C. Fleck (Tananarive), Loren T. Davis (Tananarive), and Roland Y. Danner (Tananarive). Not shown: James T. Elder (Guaymas) and Edward J. Larson (Guaymas).

Left to right: George J. Karras, Wallops Station Director and David E. B. Wilkins.

Richard A. Lavoie, (Kano)



Joseph E. Bryant, (Wallops)

The "Mystery" of the Tower on Top of Bldg. 3

If you've ever come in or gone out of the main entrance to Goddard, and that ought to include about everybody, you've probably noticed the tall tower on top of Building 3. You've also probably wondered what it is.

Admittedly, it looks like an oil-well derrick with three rings or bands around the top and some kind of loudspeaker device, also at the top, aimed at the Washington-Baltimore Parkway. There's also something that resembles a basketball backboard beside the "loudspeaker."

According to Bill Dickinson, Communications Engineering Branch and Goddard's representative for the design and installation of the tower, the top is about 135 feet from the ground. Built on top of a modern building, the tower *is* a pretty imposing sight.

What's this tower for? What does it do?—A lot of people here at Goddard know, but for those who don't and who are interested, here are the facts.

It's a microwave tower. "This tower," said Dickinson, who heads a group of data transmission engineers, "is one of a network of such towers spread across the United States and are all owned by American Telephone and Telegraph Company. This tower and others that Goddard uses are leased and are spaced about 30 miles apart. They automatically receive, amplify and retransmit microwaves. Microwaves are short radio waves which travel in straight lines. Like lightwaves they can be reflected and concentrated, and they can easily pass through rain, fog, and smoke which lightwaves cannot.

Building 3's tower is Goddard's link to two satellite data acquisition facilities (DAF). More DAF's are planned for the future. One DAF is at Rosman, North Carolina, 400 miles away; the other, near Fairbanks, Alaska, 6000 miles away. They are both connected to Goddard by microwave towers.

Information or data received in the form of radio signals from a satellite at one of these data acquisition facilities is sent, via the microwave towers, to Goddard. Here it's inserted into data reduction equipment, digested and reconstituted in the form of pictures or scientific information. All of this takes place almost instantaneously, or in what is called "real-time."

The data, (information, photographs, etc.,) recorded by a satellite as it speeds around the world is stored inside it. When it passes over Rosman, or Alaska, this data is picked up and sent by DAF to Goddard.

The Building 3 tower proved its ability during the recent Nimbus weather satellite flight. Photos taken by cameras on Nimbus, when it was over the coast of Africa, for example, were sent by the satellite to Rosman, when it passed overhead, then via the microwave towers to Goddard and were developed at Goddard while the satellite was still over Rosman. Speedy, huh!

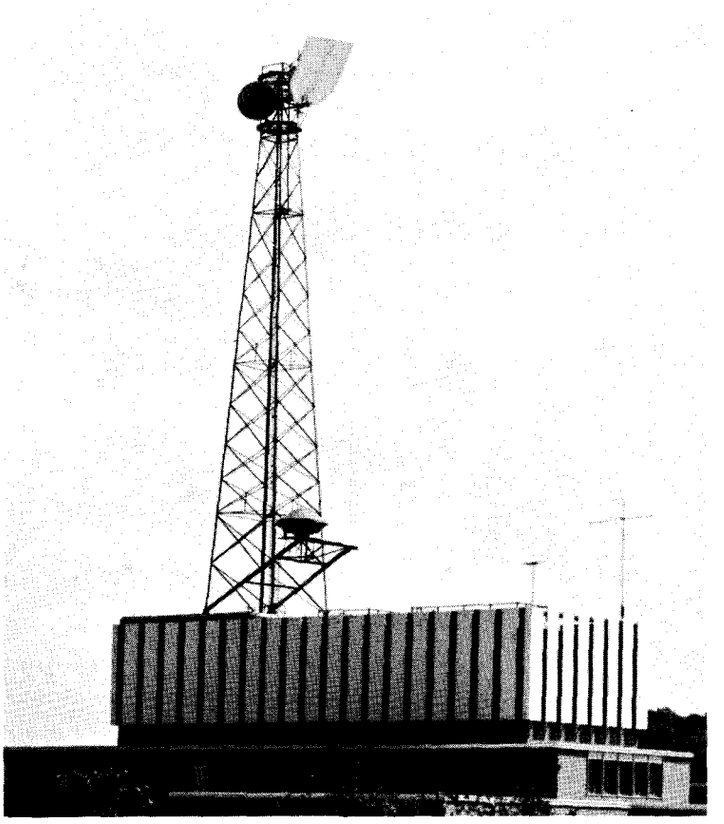
But there's more. These photos of the African coast were then relayed via our tower, and all of this at the same time mind you, to the National Weather Satellite Center at Suitland, Maryland.

Have you noticed the object on top of the tower that looks like a basketball backboard? Well, that's the dish, a parabolic dish to be exact, that sends information and photos to the weather bureau, 21 miles away. It's their link with us. Actually the dish looks just like, and is like the one pointed toward the Parkway, but it's now covered to protect it from the weather.

The Parkway-pointed dish or loud speaker-looking device is actually pointed at a tower in Garden City, Arlington, Virginia, about 25 miles away. All microwaves signals to or from Goddard, except the one to the weather bureau, of course, go to this tower in Arlington.

Any microwaves being sent to Goddard from either Rosman or Alaska pass through this tower in Arlington. The lanes of all microwave towers are kept clear of obstruction by Federal law.

"Giving commands to a satellite in orbit, via microwave and DAF is also an important function of Goddard's tower," Dickinson



explained. "Imagine the problems if the scientists who had experiments aboard a satellite all had to go to places such as Rosman and Alaska to control and coordinate their experiments with other scientists scattered throughout the United States. That's the way it used to be. Of course, previous satellites didn't have as many experiments on board, and the problem might not have been so great," said Dickinson.

For example, OGO, the Orbiting Geophysical Observatory, which was launched September 4th, has 20 scientific experiments on board. This is the most ever, and could have presented real coordinating problems. Thanks to our microwave tower, however, the scientists who placed the experiments on board can now gather all in one place, here at Goddard, and via the microwave towers, give commands to the satellite as it passes over Rosman or Alaska.

Dickinson went on to say, "that the tower's equipment is housed in the vertically paneled building under the tower on top of Building 3. The control panels for sending and receiving to a satellite are located in the basement. The tower provides one megacycle of information bandwidth from Rosman, and a capability of 96 kilocycles with Alaska. This means, basically, that the capability for transmitting scientific data from Rosman is about six times as great as that from Alaska. The capability from Alaska will eventually be made greater though," he added.

The tower had been used to check out various project equipment, but Nimbus was its first operational job. It was used successfully with OGO, and has a king size job ahead of it providing data communications with Rosman and Alaska for the Orbiting Astronomical Observatory (OAO). This is the largest scientific satellite now being planned. It weighs 3,300 pounds and is scheduled for launch in 1965.

Well, there you have it. If, one of these evenings you're delayed in a long line of traffic backed up from the main gate past Building 3, you can look over at the tower and have some idea of what it's doing there. It's Goddard's direct communication to any satellite that passes within range of the data acquisition facilities at Rosman, North Carolina, or Fairbanks, Alaska.

A Brushless Electric Motor Selected For Use In Apollo

Goddard's Philip A. Studer, Edward J. Devine and Harold E. Evans, all of the Mechanical Systems Branch were instrumental in the development of a sealed brushless electric motor, that has proven so successful that it has been selected to perform a life support function in the manned Apollo spacecraft.

One version of the new brushless DC (direct current) motor will power the cabin fan in the life support system of the Lunar Excursion Module. This is the vehicle in the Apollo project which will ferry two astronauts between the Moon's surface and the Command Module as it orbits the Moon.

A brushless motor of this design will power an instrument unit coolant pump on the Saturn launch vehicle which will launch the Apollo spacecraft. Still another of these new motors will power an experimental static discharge device on the Gemini two-manned spacecraft to eliminate static discharge built up during flight.

A DC motor is ideally suited for spacecraft use since the power sources and energy storage systems used in space are almost universally direct current. The barrier to this type of motor, however, has been the short life of conventional brushes in space. Brush life in the space vacuum can be measured in minutes because of the lack of lubricating moisture necessary to prevent excessive friction.

The new motor eliminates these problems by utilizing photo-optical detectors and transistorized switching elements which duplicate the functions of conventional brushes and commutator without physical contact of the rotating parts. Environmental tests of this motor show that it has a predicted operational life of one year.

Goddard originally developed the motor under contract with Sperry Farragut for use in powering instrumentation aboard its unmanned spacecraft. Initial use of the novel motor includes drive systems for spacecraft tape recorders as well as power systems for reaction wheels. Such control wheel systems are designed to stabilize spacecraft by reacting against undesirable motions in the vehicle.

The ultimate use of the brushless DC motor aboard spacecraft dictates stringent size, weight and operating requirements. The prototype model of this motor designed to produce one half watt of power weighs only eight ounces and measures an inch and a quarter in diameter by two and three quarters inches in length. It achieves 65 percent efficiency in converting battery power to mechanical power.

Other desirable features of this new motor are its fast response time of two thousandths of a second and its control at low power levels of a few thousandths of a watt. These features make the motor particularly useful for servo applications. Because this motor has no brushes, it also reduces static radio noise and eliminates the sparks produced by brush motors.

The versatility of the sealed brushless DC motor gives it extensive potential industrial application. For example, it could be used in hazardous atmospheres such as those in ammunition factories, coal mines or flour mills where sparks from conventional brush motors might cause an explosion.

Since it eliminates the brush wear problem, the brushless DC motor exhibits extended unattended operating life. Due to this advantage, it could replace brush motors in places where the motor is difficult to reach for maintenance. As a pump motor, the sealed unit could even be immersed in the liquid being pumped.

The subject of interest here is the sealed brushless DC (direct current) motor originally developed under contract by Goddard for powering instrumentation aboard unmanned spacecraft. Incidently, the young lady holding the motor is Miss Susan Schubert of the Facilities Support Branch.

(From Page 3)

TIROS IX

world's surface. All of the pictures so far have been at apogee, or the furtherest point in the orbit.

In about three months, perigee will be in a favorable position with the sun so TIROS can start taking pictures at about 450 miles, and the photos should be sharper in contrast. Map makers could paste together one day's collection of pictures and make a complete globe of the world.

TIROS IX has been in orbit a short three weeks and has a long way to go to break the endurance records of TIROS VII and VIII which have been operating for 19 and 13 months respectively. But as young as the new satellite is, it has the distinction of being the first of the family to roll through space like a wheel.

The curtain won't close for some time for either TIROS or Delta. As the Goddard News goes to press the workhorse Delta is getting ready for Delta #29, an Orbiting Solar Observatory satellite.

And TIROS IX has paved the way for the debut of America's first operational weather satellite program, the TIROS Operational Satellite (TOS) system which is scheduled to go into operation later this year.

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"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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