OGO-B ARRIVES HERE—This was the scene at Andrews Air Force Base early on the morning of April 11. The spacecraft traveled the rest of the way to Goddard by truck. Here we see a truck loading from the plane which brought OGO-B from the contractor, TRW Space Technology Laboratory. The experiments will be integrated into the spacecraft here and tested in the large space simulation chambers in building 10—one of the biggest challenges to date for the test and evaluation division.

Network Skin Tracks GT-1 With New Narrow-Beam Radar

They said it couldn't be done — they said nobody could do it, but Goddard skin tracked GT-1, the whole way through it!

While not quite as catchy as the slogan it is derived from, the statement above is much more significant in terms of accomplishment.

Skin-tracking is network terminology for tracking a "dead" object, that is an object which has no beacon or other on-board electronic tracking or aiming aid. Literally, it involves tracking the target by first computing its orbit and then—as the term implies—bouncing the signal off the skin of the vehicle.

Another First for Goddard

In spite of the success of the manned space flight network in skin tracking the Saturn SA-5 vehicle (still in orbit), radar experts deemed it highly improbable that "C" band radars would be capable of acquiring and tracking as small an object as the GT-1 vehicle.

This payload (approximately 1/3 the size of the Saturn) consisted of the Gemini boilerplate spacecraft, adapter and second stage of the Titan launch vehicle.

However, during the skin track phase of the GT-1 mission the tracking network managed by Goddard provided excellent tracking data to our computers during the decay phase of the mission.

"It was the first time that a vehicle was skin tracked in a real-time computing mode," according to James J. Donegan, chief of the data operations branch. "It was further learned that it was possible to supply acquisition data to the new generation 'C' band radars (FPQ-6) accurate enough to permit them to acquire and autotrack the GT-1 vehicle in the skin track mode without the use of acquisition aids."

Since the FPQ-6 has an extremely narrow beamwidth, there was some doubt about its ability to acquire such a target.

GT-1 was tracked from lift-off through orbit for 4.2 days to approximately one orbit prior to reentry when the vehicle phased off the range.

The radar operators at all the manned spaceflight network sites who participated deserve special recognition for proving it *could* be done.

FPQ-6 Radar

GODDARD NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

VOLUME VI, NUMBER 12 MAY 4, 1964

Kennedy Portrait to be Hung Here

Ted Psaropoulos was already working on a portrait of the late President when news reached him of the assassination in Dallas. He finished it with an extra measure of care and dedication that was borne of the grief which we all shared. Now, the portrait is to be hung in building 8 near the entrance to the auditorium.

Ted is a technical illustrator at Goddard's Institute for Space Studies in New York City, but portrait work has long been a hobby as well as a full-time vocation at one point in his career. (See story on Ted in INSIDE GODDARD, January 13 issue.) He was born in Athens, Greece.

On April 24, Dr. Michael J. Vaccaro, assistant director, office of administration, formally accepted the portrait for display here at the Center. It will remain the property of the artist on loan to Goddard.

Psaropoulos is no novice at portrait work. His paintings hang in homes and galleries in 32 states and 11 nations. Among his many honors, he has received first prize for a portrait of two children exhibited at New York's Riverside Museum.

The Kennedy portrait has been examined by a New York museum and appraised at more than $5,000. But, due to his generosity, it is to be ours to enjoy—free.

Dr. Michael J. Vaccaro (left) receives the painting for Goddard.

Division Chief Discusses Solar 'Shock Wave'

Dr. Wilmot N. Hess, chief of Goddard's theoretical division, had some interesting things to tell the annual meeting of the American Physical Society in Washington last Monday. His topic was "The Magnetosphere and Magnetopause." His comments, which follow, deal with the actions of the solar wind of charged particles which flows around the Earth's magnetosphere like "the supersonic blast of air in a shock tube."

Dr. Hess' Presentation:

The Earth in several respects is similar to a blunt object exposed to the supersonic blast of air in a shock tube. The Sun blows a wind of charged particles at the Earth. Recent satellite measurements show that there is a bow shock wave upstream from the Earth behind which energetic particles are found. This shock has several interesting properties.

We have known for some time that the solar wind has strong effects on the magnetic field of the Earth. The magnetic field of the Earth does not fall off gradually extending to infinity as it would if a bar magnet were placed in a vacuum. The Earth is not a vacuum. It is in the atmosphere of the Sun. The outer atmosphere of the Sun, called the corona, is heated to about one million degrees centigrade probably by waves coming up out of the Sun. This makes the corona unstable. It expands and blows a solar wind towards the Earth. The straight long tails seen behind some comets have led to the suggestion in about 1950 the Sun was blowing a particle wind outwards. This solar wind has been measured directly by several satellites including Explorer X, Mariner and IMP. The wind blows about 500 km/sec and is composed of an ionized plasma of protons and electrons. This wind is a good electrical conductor and when blowing against the terrestrial magnetic field pushes it away. It pushes on the magnetic field and distorts it until the magnetic pressure due to the distorted field balances the pressure of the solar wind. The Earth and its field are confined to a "cavity."

The shape and nature of the back side of the cavity are rather uncertain but it probably closes off in 100 Earth radii or less. This cavity is called the magnetosphere and its outer boundary the magnetopause.

It had been suggested that the

Dr. Wilmot N. Hess

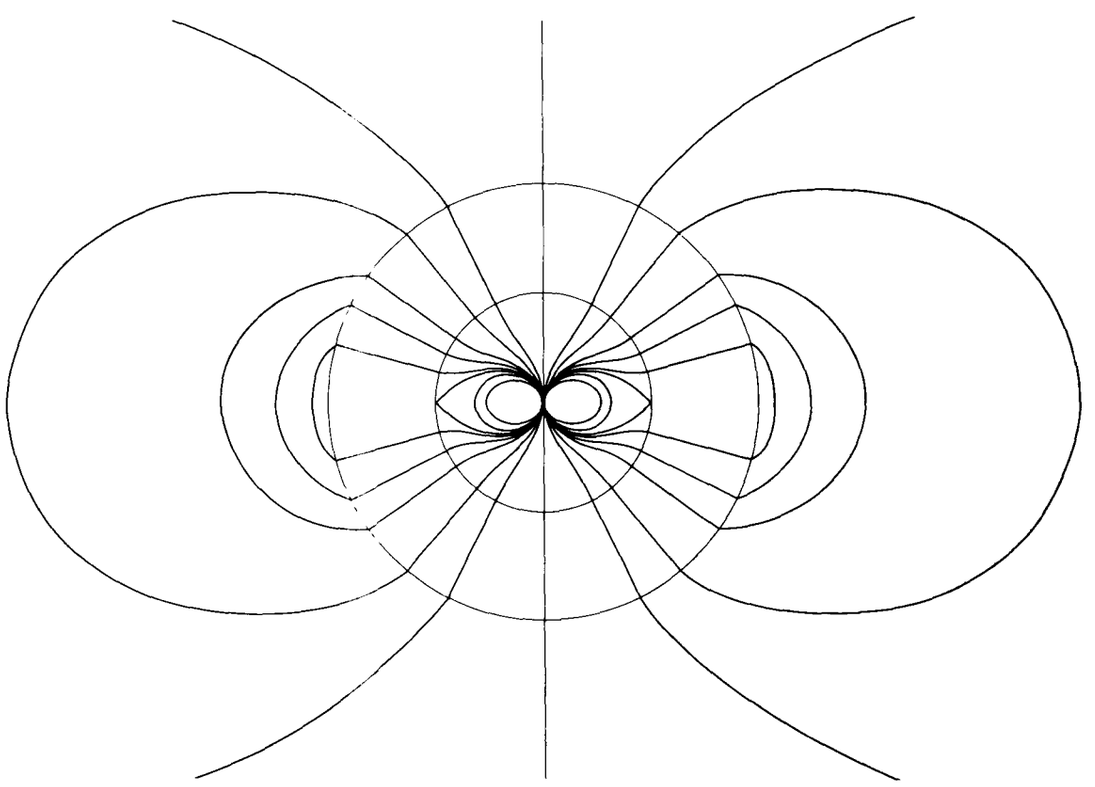
solar wind, which is supersonic, might make a shock wave upstream from the magnetosphere in the same way that a high velocity bullet has a shock wave ahead of it. The IMP satellite developed by Goddard and launched last November carried experiments to study the magnetic field, solar wind and energetic electrons and protons out to 30 Earth radii distance. Several measurements on IMP have clearly demonstrated the existence of the shock wave (see GODDARD NEWS, April 6, issue, p. 8).

The magnetometer flown by Ness of Goddard showed the sudden magnetopause transition from the terrestrial field to a disordered generally smaller field at about 10 Earth radii towards the Sun as expected. Then at about 13 Earth radii a second transition occurred. From the disordered turbulent field the field changed to an ordered field of quite constant magnitude and reasonably constant direction. This is clearly the interplanetary field outside. At this same location the solar wind experiments of Bridge of MIT and Wolfe of Ames also see a transition.

The solar wind outside comes radially from the Sun and is composed of protons of about 500 ev energy. In the region inside this "shock" at 13 Earth radii the particles are moving in all directions not radially from the Sun and the proton energies extend up to several Kev. Electrons of several hundred ev energy are seen here too, but not outside the shock. This situation seems rather similar to a shock in supersonic aerodynamics behind which there is a turbulent region hotter than outside the shock with particle motions random. But there is a significant difference here. There are essentially no collisions between particles in the solar wind so this is a collisionless shock where the magnetic field plays a significant role in making the medium a continuum.

Future Study Slated

The future study of this shock should provide information not easily accessible in the laboratory about magnetohydrodynamics. The turbulent zone inside the shock may be the birth place of many of the energetic particles in the outer radiation belt.



This is not a Rorschach test. It isn't even the latest drawing of the Glenn Dale road-Parkway interchange. It's not two romantic water beetles either! In case you're wondering, it's Dr. David Stern's concept of the lines of force of the interplanetary magnetic field, for the limit of high conductivity from an axial dipole source. What did you think?

News About Space & Aeronautics

● Visitors to the New York World's Fair will be treated to an upward look at the "business end" of the National Aeronautics and Space Administration's mammoth Saturn V moon rocket at the space exhibit.

A full size mockup of the thrust structure of the three-stage rocket's booster, the S-IC stage, will rest on four support piers with the five huge F-1 engines 12 feet above the ground.

Fair visitors will be able to walk beneath the 85-foot-tall structure and gaze upward into the nozzles of the 10-ton engines which will give the real Saturn V booster a total thrust of 7.5 million pounds.

The complete booster will be 138 feet tall and 33 feet in diameter. With all three stages assembled and the Apollo spacecraft mounted atop, the Saturn V will tower some 360 feet into the sky.

• • •

● On April 14, Goddard launched a modified four-stage solid propellant Javelin (Argo D-4) sounding rocket carrying a 120-pound payload of instruments and equipment for tests of in-flight characteristics of the X258 solid propellant rocket motor and, as a secondary mission, to conduct scientific investigations in the ionosphere. The test is part of the X258 development for use in satellite launching vehicles and, possibly, for the sounding rocket program.

The X258, manufactured by the Hercules Powder Company's Allegheny Ballistics Laboratory, was developed from the X248. The X248 has been used as the upper stage for such satellite boosters as the Delta and Scout and is the standard fourth stage of the NASA's Journeyman and Javelin sounding rockets.

The Javelin, with the X258 replacing the regular X248 fourth stage, was launched from Wallops Station.

The rocket reached an altitude of 452 statute miles. Approximately 15 minutes of data were telemetered to ground stations before the fourth stage and payload impacted in the Atlantic Ocean 642 miles from the launch site.

If the X258 is used as the fourth stage for the Javelin, it would push the vehicle's altitude capability with a nominal payload (50 pounds) from its present 600 miles up to about 700 miles.

Development of the X258 program is under the direction of NASA Headquarters. Langley Research Center is responsible for program management. John F. Corrigan is the project engineer for Goddard and project scientist for the flight test was John G. Guidotti, of Goddard's sounding rocket branch. The Goddard ionosphere investigations were conducted by J. L. Donley and L. H. Brace.

• • •

● Then, on April 16, this Center launched an ionosphere experiment for the University of Illinois and the Geophysics Corporation of America—also from Wallops.

The 60-pound payload was flown on a two-stage Nike-Apache vehicle, and carried instrumentation to measure electron and ion density and solar radiation in the D and E regions of the ionosphere.

This experiment is part of investigations being made during the International Years of the Quiet Sun, 1964-65 (IQSY). This is the period during which solar flares and sunspot activity are at a minimum level during the 11-year cycle. Ground-based soundings of the ionosphere are being made by several techniques in support of this sounding rocket experiment in various other countries.

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.

This nation can well afford the development of its space exploration capability, the trip to the Moon and the price of the high adventures to follow, according to Dr. Hugh L. Dryden, NASA's Deputy Administrator.

In an address to the Economic Club of Detroit, Dr. Dryden pointed out that the total NASA space program costs the nation about 50 cents a week per capita. This, he noted, is less than Americans spend on cigarettes and alcohol.

Dr. Dryden said that the Apollo manned lunar landing program "represents a unifying goal, an incentive, and a spur to achievement. In a sense the trip to the Moon makes an ideal goal, since it is difficult enough to require us to build a new and vital technology but not so difficult that it cannot be accomplished."

Dr. Dryden emphasized that the Apollo program is an "orderly" one and not a "crash" program as sometimes charged. He said the program is "a well planned effort at nearly the optimum rate, i.e., that which produces the minimum overall cost to reach the stated objective. If adequately financed and no unknown insuperable problems arise, we expect to reach our objective of lunar landing and return within this decade."

"The Moon is the first way station on a journey soaring outward into infinity," Dr. Dryden said. "This nation's ability to lead the world in space endeavors depends chiefly on our solving the problems inherent in the first lunar landing as quickly as possible, and on getting ourselves ready for the next steps—both peaceful and defensive—which the world's leading spacefaring nation must take."

The Deputy Administrator noted that the first venture into space, Sputnik I by the Soviet Union, "could have been ours—we had the ability . . . but not the foresight or the determination to do it.

Dr. Dryden

"In the years since, this country has done much to atone for that mistake, and most people today realize we cannot remain a leader of the Free World nations unless we pursue the exploration of space with all the resources required. This is not merely a question of national prestige — our national security is inevitably involved."

GODDARD NEWS

"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

The Goddard News is a bi-weekly publication of the National Aeronautics and Space Administration's Goddard Space Flight Center, Greenbelt, Md., suburban Washington, D. C.

Phone—Ext. 4141 or 4142

Bruce Brough, *Editor* Shirley Deremer, *Inside Goddard*

New Display and Distribution System for Gemini—

When American astronauts Grissom and Young are rocketed into orbit in their two-man Gemini spacecraft, an in-flight display and distribution system located at eight of Goddard's manned spaceflight tracking sites around the world will monitor every action of the men and monitor their environment.

As Project Gemini develops, an unmanned Agena spacecraft will be placed into orbit and a Gemini capsule containing two astronauts will follow in a slightly lower orbit. The astronauts, with help from ground controllers, will jockey their spacecraft into position to a rendezvous and actual mating of the two vehicles.

In order to support such complicated missions, the Gemini display-command systems will be as much as 40 times more complex than those used in Project Mercury.

The complexity of the Gemini mission involves the use of more than 500 lights, meters, switches and dials to monitor the Gemini vehicle and the Agena spacecraft.

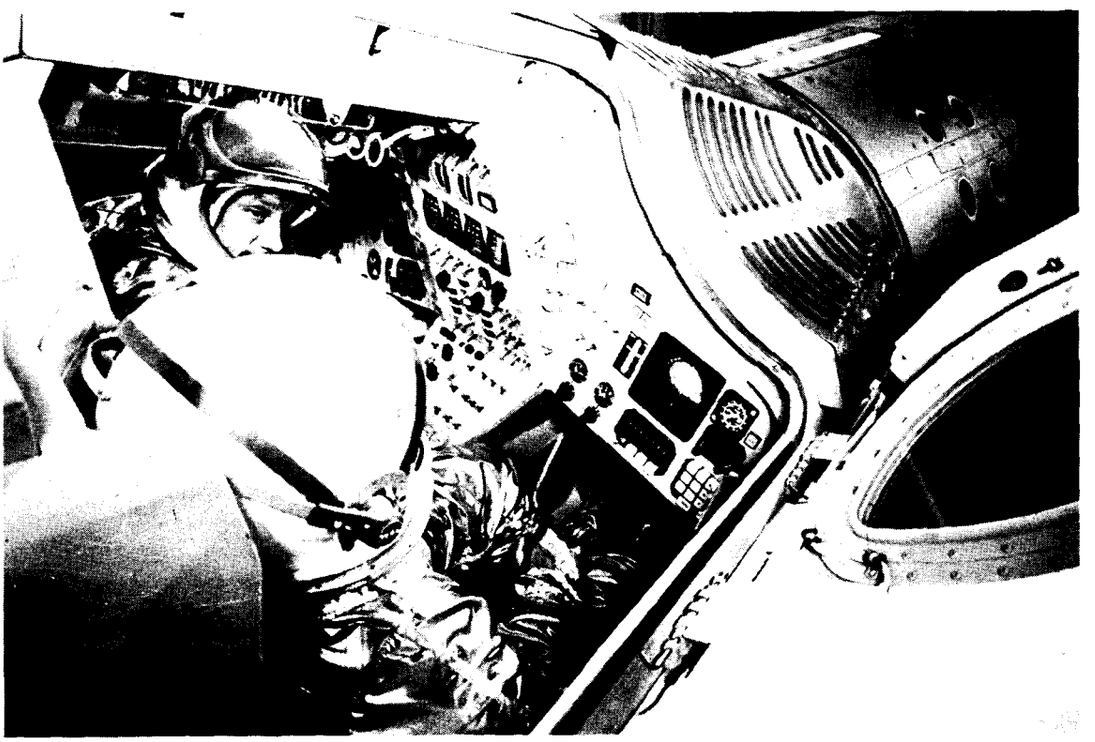
After Goddard's manned spaceflight tracking network received Manned Space Flight Center's document of requirements for the Gemini support system, Virgil F. Gardner of the manned flight engineering branch was selected as technical officer for the Gemini display and distribution system.

In this role, he coordinated the evolvement of the system with specialists in the branch. Key personnel who worked with interfaces in various areas were: George Harris, Jr.—PCM telemetry; Don Dalton and Charles Underwood—DCS command; John Arslanian—timing; Jack Koslosky—intercom; Sidney Lechter—data processor; Jerry Hartman — acquisition aids; and Robert Spearing—RF command.

The equipment was developed by the Bendix Corporation's Bendix-Pacific division under a $5 million contract for the manned spaceflight tracking network and is now being installed.

The system consists of five separate consoles. Four will be manned by one person each. The aeromedical console is able to accommodate two physicians if required.

One of the 28 other astronauts who will not be flying on that particular mission may be



Sure, there are a lot of switches, buttons, dials and guages in the cockpit of the Gemini capsule. But there is a lot more to the mission than that. An even more complex system is being installed at manned spacecraft tracking network stations. The display and distribution system now being readied for the manned missions is a wonder of modern technology built on the experience gained during Project Mercury.

BY A NON-GODDARD TYPE:

One Definition of a Scientist

A scientist is one who, when asked to seek a solution to a problem which was initially phrased in language of such simplicity that a layman could guess at its solution, is capable of drawing upon years of experiences with pseudo-analogisms couched in the formulation of mathematical relationships arising from postulates deduced from assumptions concerning the probable gyrations of improbable microscopic bitlets of matter to construct suitably grandiose semi-equalities and other such vagueries of his own.

And, having written down in impressive detail all relevancies, he is able to state that while his conclusion is not precise, it is, when properly extrapolated to something resembling reality, within several orders of magnitude of the results secured by a colleague after years of research with megadollars and precision equipment—results which were often within ±10% of the exact same answer given by the layman.

—Contributed to* GODDARD NEWS *by a non-NASA physicist, Richard Hyland

Now Being Installed at Eight Tracking Network Sites

stationed at the command communicator console; flight controllers will be at the Agena and Gemini systems monitor consoles; one or two physicians will sit at the aeromedical console and the station supervisor will be at the maintenance and operations console.

Center of Activity

The command communicator console, similar in concept to the ones used during the Mercury flights, will be the center of activity for the Gemini mission.

It is at this console that radio voice communication with the airborne astronauts is conducted and some of the electronic commands are originated to the spacecraft. Some real-time commands may be initiated from the Agena and Gemini systems consoles.

On the console will be the time displays which show the ground elapsed time for both the Gemini and Agena vehicles, airborne time for both vehicles, time to retrofire, time of coincidence (command related), and Greenwich mean time (GMT).

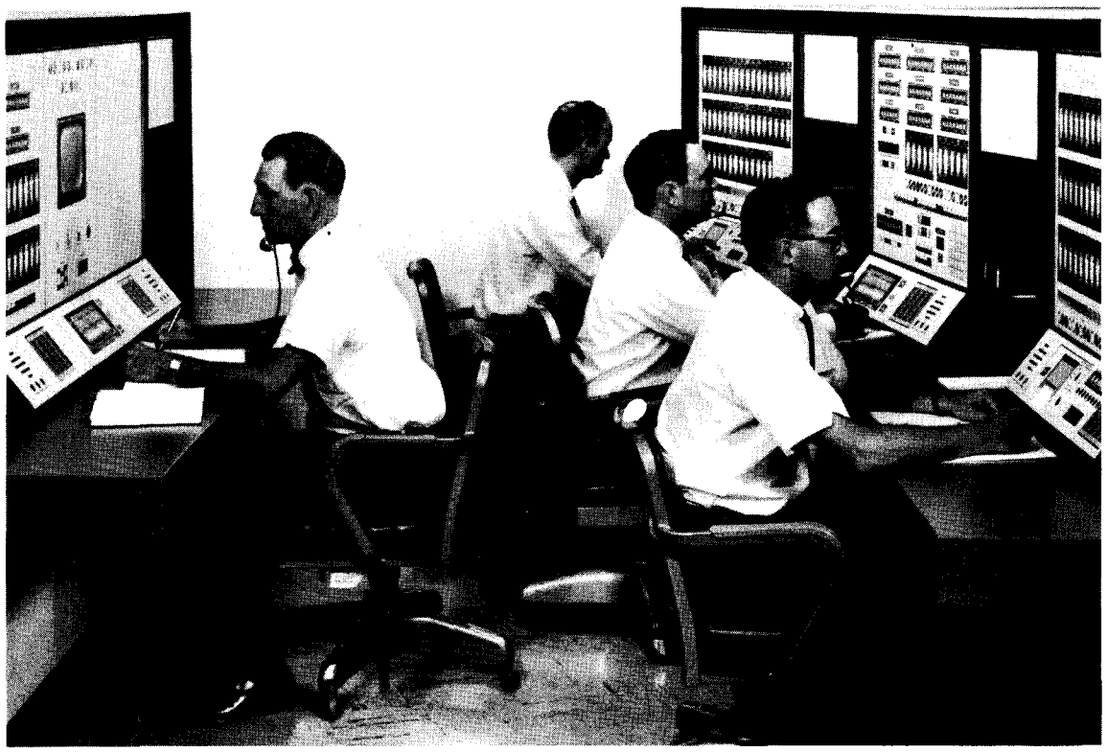
Time to retrofire is perhaps one of the most critical of all the commands because the retrorockets must be fired at the precise scheduled moment if the spacecraft is to land in the proper spot. A difference of only one second can cause the spacecraft to land as much as five miles off target.

Identical Twins Cooperate

The Gemini and Agena systems monitor consoles are identical in appearance. Each displays operational conditions of its related space vehicle, such as temperature, flight attitude, fuel quantity and electrical system status. The console can also make a permanent record of selected data on 100-word-per minute teletype machines which interface with a data processor.

Telemetry tapes will be cut during each pass which will serve as a means of additional monitoring after a pass and a permanent record of the pass.

The physician or physicians stationed at the aeromedical console will monitor all data concerning the physiological condition of the two astronauts. The console may, at some future date, be implemented to display television similar to the system used during MA-9.



Engineers can keep close tabs on human factors by monitoring the display control consoles (shown here in mock-up form) for Goddard's Project Gemini ground tracking stations. The consoles will be used at eight tracking sites around the world. By reading the meters, lights and clocks on the consoles, network technicians can check such physical and environmental data as the astronauts' body temperatures, blood pressure and pulse rate, and the spacecraft's fuel supply and cabin temperature. The position on the left is for the aeromedical observer, the technician on the far end of the right side monitors the Agena rocket. The center position is for the command communicator and the right for the Gemini spacecraft observer.

During the brief time the Gemini vehicle will be within range of a station, the medical observer will constantly follow the astronauts' heart and blood pressure as they are charted on a recorder, keep a check on cabin pressure and oxygen consumption, and monitor respiration and pulse rate from the paper records.

The cardioscope in the console will enable the physician to watch 10 different biomedical parameters, four at a time, such as 4 each electrocardiogram waveforms.

The station supervisor at the maintenance and operation console will have responsibility for monitoring all operations of the Gemini site. His console gives him the capability of monitoring the status of on-site instrumentation, synchronization of the Gemini and Agena, ground elapsed time, and communication to maintenance and operations personnel.

Intercom Network Included

An integral part of the display system is an intercommunication network so all personnel manning a tracking station can instantly communicate with each other. In addition, teletype printers in the command and aeromedical consoles will connect the various tracking stations' control rooms directly with Goddard.

"The Gemini consoles represent the latest technology in the display field," according to a Bendix executive. "We have incorporated the newest theories and latest equipment and have developed consoles with the highest possible reliability factor."

The tracking stations where the systems are being installed are at Carnarvon, Australia; Corpus Christi, Tex.; Canary Islands; Hawaii; Guaymas, Mexico; Wallops Island, Va.; the tracking ships Rose Knot and Coastal Sentry; and the Manned Space Flight Center, Houston, Tex., where two complete systems will be installed. The latter will be used in training flight controller personnel.

It looks as if Manuel Tostado (left) is an expert Italian chef, but that's not spaghetti! He is assembling a cable system for one of the Project Gemini data distribution frames under construction at Bendix-Pacific Div. of The Bendix Corp. for Goddard. The miles of wires will all be properly coupled and labeled for installation in the system.

Goddard Coming Events

Goddard Colloquium Lectures:

- **May 7, 4:00 p.m., Rm. 431, Goddard Institute for Space Studies, 475 Riverside Dr., New York, N. Y. —Dr. N. Woolf, Princeton University, "The Formation of White Dwarf Stars."**
- **May 14, 4:00 p.m., Rm. 431, Goddard Institute for Space Studies, 475 Riverside Dr., New York, N. Y. —Dr. M. A. Ruderman, New York University, "Supersonic Energy Loss by Stars and Galaxies."**

Films:

- **May 7th and 14th, 12:30 p.m., Bldg. 3 Auditorium —"Granny Versus the Weather Bureau," *(Film of recent "Beverly Hillbillies" TV program.)***

Goddard Scientists Work With Area Youth

The annual round of science fairs in America's high schools draws to a close late this week with the state and local winners competing in the International Science Fair in Baltimore May 6-9.

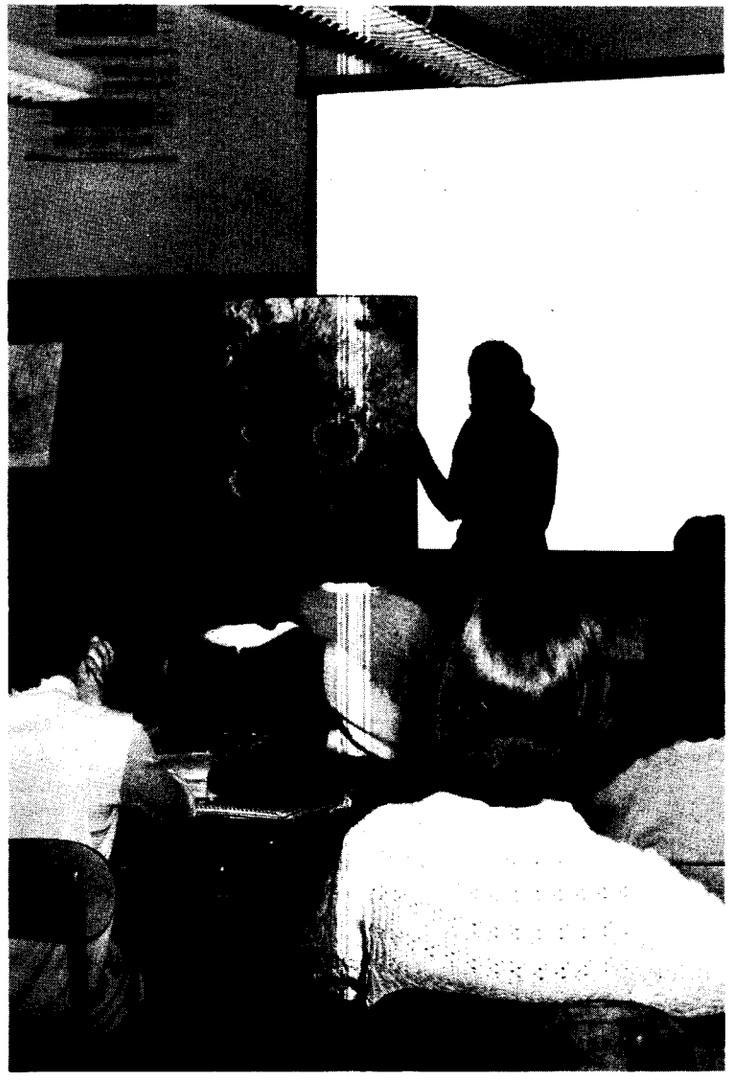
NASA will offer special awards at the national level to exhibits which are exceptional and which apply directly to space research and development technology.

As in past years, Goddard has supplied judges to help in the local and regional science fairs in this metropolitan area. The Center will also have representatives from the office of educational programs and services in Baltimore this week.

But, other than judging, how is Goddard supporting the next generation of technologists? The photographs give evidence of another method of letting the science student meet the scientist (to the enrichment of both).

At a Washington area science fair last month, not only did Goddard supply some qualified people to help with the judging; but also provided the school with two unusual "substitute teachers."

Dr. Charles C. Schnetzler and Mrs. Winifred Cameron, both scientists in the theoretical division, taught classes at Alice Deal Jr. High School while the regular teachers worked on the science fair in the school auditorium. This sort of exchange is arranged through the Washington area's Joint Board on Science Education (see last issue, p. 8).



Mrs. Winifred Cameron is discussing the lunar surface with a ninth grade science class while the regular teacher was working with the school's science fair in the auditorium.

Alice Deal Jr. High School seventh graders had a first-hand opportunity last month to discuss the planets with Goddard's Dr. Charles C. Schnetzler, theoretical div.

The benefit was not one-sided, since it is a rare opportunity for a technical person to "rub shoulders" with a new generation of students in the formative stages of career development. And, naturally, it isn't every day that junior high science classes have the opportunity to study and discuss lunar and planetary topics with experts in the field.

And perhaps—just perhaps—one or two students in question about their careers may have stepped a little closer to a decision for space research after exposure of this nature.

Summer Courses May Benefit You

The employee development branch has announced that the Department of Space Sciences and Applied Physics at Catholic University is offering three courses during summer session geared to the needs of prospective graduate students who need strengthening in applied mathematics.

An employee interested in graduate study in that department at C. U. will find a sound background in mathematics not only helpful, but essential.

These are the courses to be offered this summer:

UNDERGRADUATE

S 305—Partial Differential Equations (3)
(Text —"Part Diff Equa in Engr Problems"—Miller
5:10-6:30 p.m.
Mr. Laura

S 306—Linear Systems Analysis (3)
(Text—"Analysis of Linear Systems")—D. K. Chang-Addison-Wesley 7:30-8:30 p.m.
Mr. Shah

GRADUATE

S 526—Applied Math with Engr Applications 11
(Text—"Appl Math for Engrs & Physicists")—Pipes
5:10-6:30 p.m.
Mr. Shah

Courses will meet daily for a six-week period—Monday through Friday.

Ed McHugh, employee development officer, notes that Catholic University is not offering any similar courses in applied physics this summer—a point which reinforces the importance of considering the math opportunity at this particular time.

Employees who can demonstrate that these courses relate to their assigned work at the Center are eligible for tuition assistance from employee development. For further information, contact Ed McHugh on extension 5150.

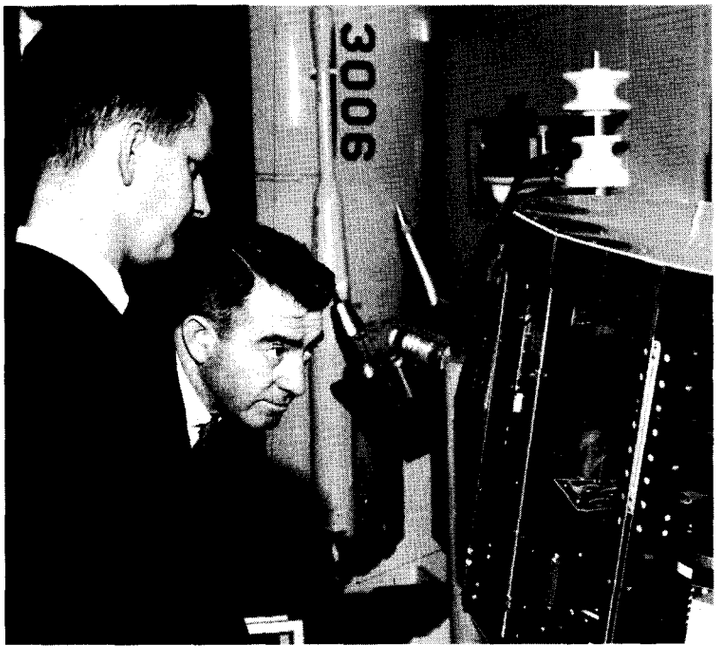
Seventy-four Attend Calculator Class Here

Seventy-four individuals participated in an in-service short course entitled "Use of Friden Calculators."

The one hour and 45-minute class was attended by eight groups of employees on April 7 and 8 in a classroom in building 16. It served as a refresher for experienced calculator users in fundamental methods of operation.

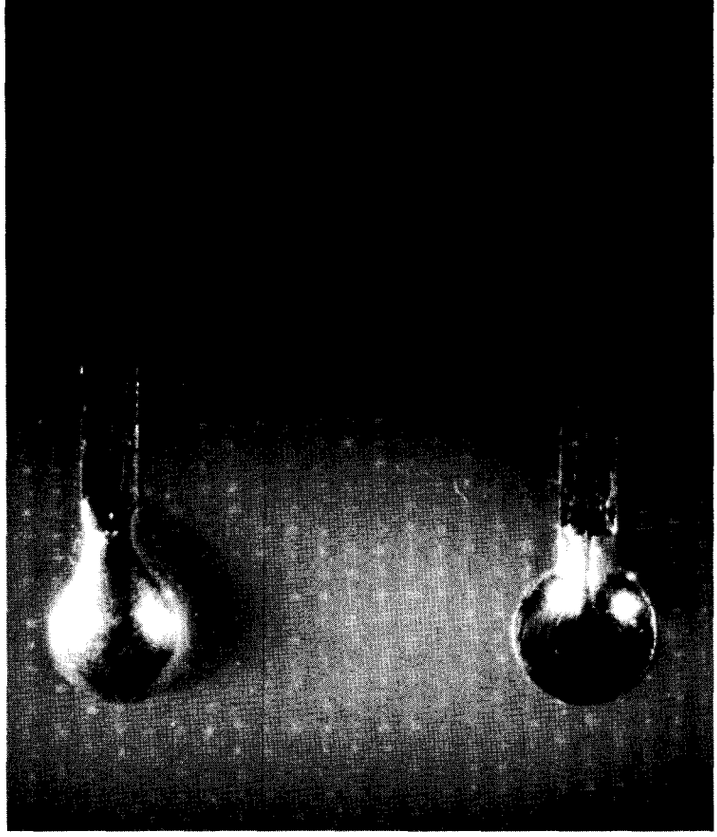
In addition, the sessions introduced both old and new operators to new techniques applicable to a variety of Friden machines.

The instruction was provided by company representatives in cooperation with the employee development branch, according to branch head, James Reese.



Jon Arneson (left), office of public affairs, is pointing out features on the cutaway model of Syncom to State Senator James Clark, Jr. from Maryland's Howard County on a recent informational tour of the Center.

More Soldering Classes



Due to interest in the first series of soldering classes (Apr. 20 issue, p. 2), five more have been scheduled for fiscal 1964 according to John Stokes, instructor. Above is an example of why the school is necessary. These tiny solder joints are enlarged five times in the photograph. On the right (a "good joint") we can see the contour of the wire. On the left, the wire is unrecognizable. There is no non-destructive way to test a solder joint that is not able to be visually examined. So—soldering school is a must.

Goddard Speech and Paper Presentations

(Technical presentations approved as of April 27, 1964 for period through May 17. Requests for copies of speeches and papers should be made directly to the author.)

SPEECHES

W. G. Stroud, 4th National Conference on the Peaceful Uses of Space, Boston, Mass., April 29 thru May 2, 1964, ***"A Report on the National Meteorological Satellite Program."***

Albert L. Hedrich, 4th National Conference on the Peaceful Uses of Space, Boston, Mass., April 29 thru May 2, 1964, ***"Communication Satellite Technology."***

Edward Mason, Telephone Pioneers of America, Clearwater, Fla., May 2, 1964, ***"Space Exploration at the Goddard Space Flight Center."***

Dale W. Harris, IEEE, Clearwater, Fla., May 4-6, 1964, ***"An Analytical Determination for the Efficiency of Segmented Thermoelectric Couples."***

A. G. W. Cameron, American Society for Public Administration, New York, N. Y., May 7, 1964, ***"A Scientist Looks at Public Administration."***

A. G. W. Cameron, Educational Broadcasting Company, Channel 13 Program: Challenges of Space Age Exploration, May 5, 6, and 8, 1964, ***"Space Hazards."***

T. Neil Davis, National Academy of Sciences Committee on Polar Research, Boulder, Colo., May 6, 1964, ***"Evaluation of Antarctic Auroral Investigations Since 1957."***

John C. Lindsay, Macbeth Corporation, Newburgh, N. Y., May 7, 1964, ***"Exploring Space"*** and ***"The Orbiting Solar Observatory."***

J. B. Martin, Rotary Club, Oswego, N. Y., May 12, 1964, ***"GSFC Global Tracking Networks."***

Paul A. Lantz, IEEE Professional Technical Group on Space Electronics and Telemetry, San Francisco, Calif., May 12, 1964, ***"NASA Space Data Acquisition Antennas."***

Myron Lecar, Yale University, Department of Chemistry, New Haven, Conn., April 20, 1964, ***"Exploring the Moon."***

A. G. W. Cameron, 45th Annual Meeting of the American Geophysical Union, Washington, D. C., April 21, 1964, ***"Geophysics for the Physics Student."***

Patrick Thaddeus, 45th Annual Meeting of the American Geophysical Union, Washington, D. C., April 22, 1964, ***"Structure of the Venus Atmosphere."***

Hong-yee Chiu, Yale University, Astronomy Department, New Haven, Conn., April 22, 1964, ***"Astrophysics–Neutron Stars."***

S. Ishtiaq Rasool, 45th Annual Meeting of the American Geophysical Union, Washington, D. C., April 22, 1964, ***"The Ionosphere of Jupiter."***

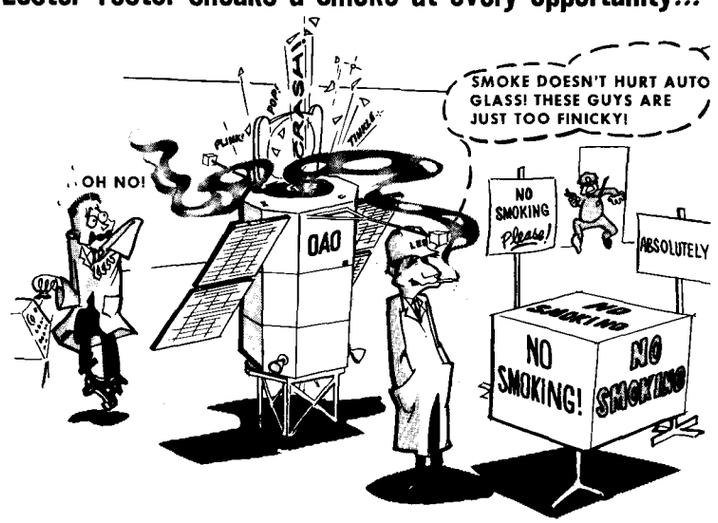
Robert Jastrow, Walden School—50th Anniversary, New York, N. Y., April 24, 1964, ***"Transformations Wrought by the Scientific Revolution."***

PAPERS

William W. Wolman, National Convention of the American Society for Quality Control, Buffalo, N. Y., May 4-6, 1964, ***"Reliability and Systems Engineering."***

Winifred S. Cameron, Conference on Geological Problems in Lunar Research, New York, N. Y., May 16-19, 1964, ***"An Interpretation of the Lunar Sinuous Rilles."***

Lester Tester sneaks a smoke at every opportunity...



WHAT NEXT?

Metallic Blanket for OGO Boom

"What next in the panorama of unusual jobs performed at an unusual place like Goddard?" you may wonder. How about tying five wrappings of aluminum-coated mylar plastic around a boom with a ball on the end?

That is exactly what Wilfred Zimmerman, a contract employee of Wells Industries, is doing in these photographs. The boom keeps Dr. James P. Heppner's OGO experiment (which will measure magnetic fields) at a distance of approximately five feet from the body of the satellite.

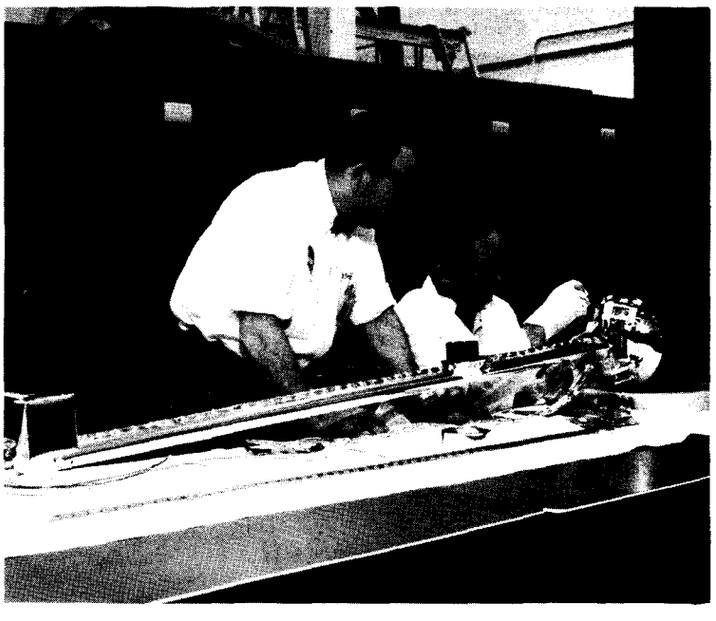
This enables readings to be more accurate, since the magnetic field generated by the spacecraft itself would interfere with the magnetometers if they were not isolated at the end of the boom. But the boom must be insulated against temperature extremes.

Zimmerman is a specialist in thermal insulation—keeping the temperature relatively constant in a given area. He is shown stitching the foil-like coating in place with nylon cord, which is used because it is non-conductive.

The picture below shows the job in perspective, including the ball which houses two magnetometers. Dave Weiner of the test and evaluation division's thermodynamics section (below, left) installed the thermocouples which measure the interior temperature of both the boom and the experiment.

Wilfred Zimmerman, complete with special gloves to keep sensative surfaces "clean," is shown tying the mylar insulation to an OGO boom.

This is just one of the areas of special skill needed on one phase of one experiment aboard the spacecraft. OGO will carry up to *50* experiments. It is Goddard's first "streetcar" satellite capable of carrying a large number of passengers.



T&E's Dave Weiner (left), who installed measuring devices in the boom and ball, looks on as Zimmerman finishes up the insulation job. This experiment, by Dr. James Heppner, is one of many scheduled to ride Goddard's "streetcar" satellite, OGO, when it is launched later this year.

How It Works—#5

Horizon Scanners

Some satellites, such as Nimbus—a future meteorological spacecraft—are designed to be stabilized in attitude relative to the earth. Nimbus carries sensors known as horizon scanners to detect its attitude so that any necessary correction may be made. This earth oriented spacecraft has two scanners looking in opposite directions, one forward and one to the rear along the orbital path (*Figure 1*). Each has a 3° x 10° field of view that revolves at about 16 rev./sec. in a cone shaped path with a 90° angle at its apex. When a portion of this path intercepts the earth, the scanner receives the earth's infra-red (heat) radiation which generates an electrical signal. When the portions of the earth intercepted by each scanner are equal, the two electrical signals are of equal duration. This will occur when the spacecraft is level in its pitch orientation, i.e., when a line drawn through the front and rear scanners lies "parallel" to the surface of the earth below.

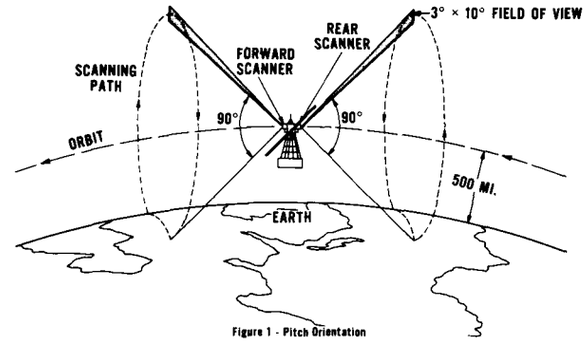


Figure 1 - Pitch Orientation

If the spacecraft pitches down, the forward scanner sees the earth for a longer time and the rear scanner for a shorter time (*Figure 2*), so the voltages produced are of unequal duration. This condition creates a signal that activates the attitude control system, returning the spacecraft to its level position. A similar sequence of events will follow a pitch up.

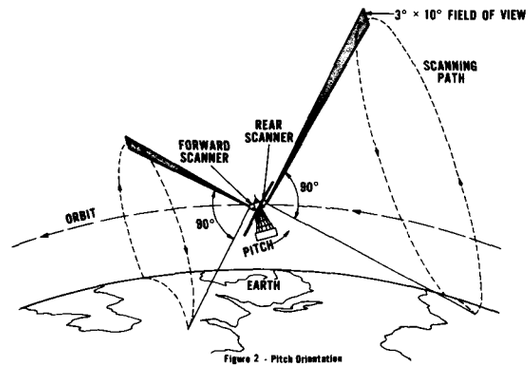


Figure 2 - Pitch Orientation

If a timing signal is provided, whenever the revolving scanner passes the 0° position (*Figure 3*), any roll motion of the spacecraft can be detected. This is done by comparing the duration of the earth's scan before the zero position to the duration after the zero position. If the two are equal (a = b in *Figure 3*), the craft is level in its roll orientation; if not, it is tilted and corrective action is applied in a manner similar to pitch correction.

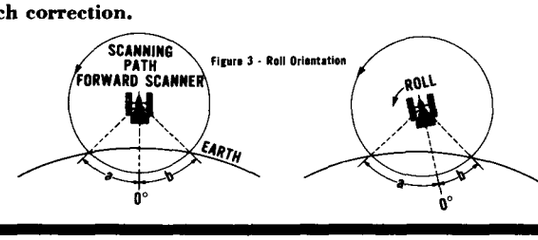


Figure 3 - Roll Orientation