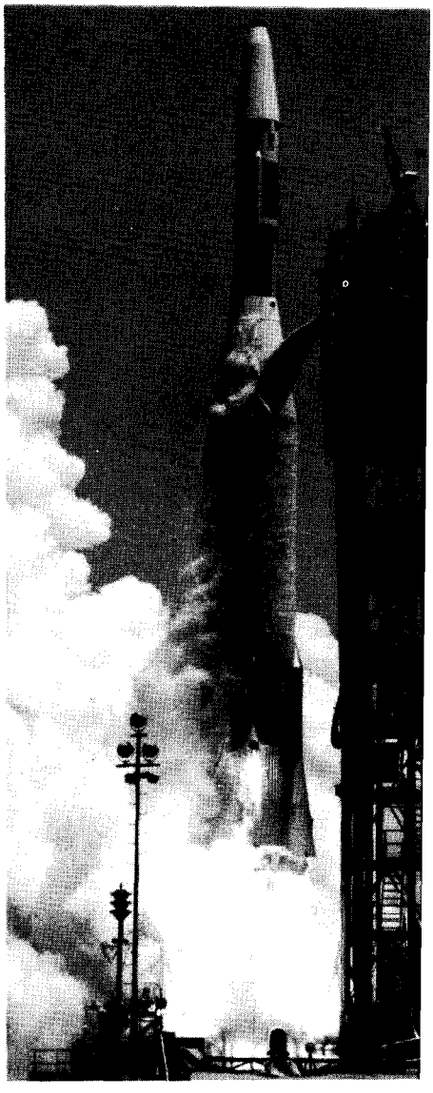
GODDARD NEWS

GODDARD SPACE FLIGHT CENTER / GREENBELT, MARYLAND

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

VOLUME VII, NUMBER 7 AUGUST 10, 1964



The picture of the moon's surface is from Ranger 7, shown at right during launch from Cape Kennedy by Goddard's launch operations branch. The photo shows the lunar surface from an altitude of approximately 25 miles. See pages 4 & 5, inside, for a special section of Ranger pictures.

President of Malagasy Republic 'Drops In'

The first head of state to visit Goddard literally "dropped in" July 29. His Excellency Philibert Tsiranana, President of the Malagasy Republic, and his official party arrived directly from the White House in three helicopters.

After landing in the mall in front of building 8, they were greeted by Dr. Harry Goett, Goddard's Director, and Mrs. Goett.

Their stay at the Center included lunch with the Director, a tour of the facilities, and then departure for a brief tour of the adjacent Agricultural Research Center. Then the group returned to the helicopters on the mall and departed.

Accompanying the President of Malagasy was his wife, the Malagasy Foreign Minister, their Ambassador to the United States, and officials from the U. S. State Department and NASA Headquarters.

Malagasy has a population of more than five million, and is located in the Indian Ocean off the east coast of Africa. The Republic occupies one of the largest islands in the world — Madagascar — nearly 1000 miles in length with a maximum width of 360 miles.

(Cont'd on p. 2)

The three White House helicopters are in view here as Goddard's director, Dr. Harry J. Goett, walks toward building 8 with the President of Malagasy.

AT THE CENTER:

STADAN Conference Plans Ahead

A STADAN (Space Tracking and Data Acquisition Network) Supervisor Engineers Conference was held last week —Monday through Friday—at Goddard and Bendix Field Engineering Corp. Headquarters in Owings Mills, Md.

Station managers from the network, which is operated for Goddard by Bendix under contract, were called in from the field for this conference.

The purpose of the meetings was to update the personnel involved on current policies, plans and happenings. The time at Goddard—Wednesday and Thursday—was spent in briefings and tours to familiarize the station managers with the Center's plans for the future and current systems and procedures.

Exchange Between U.S. and Orient Aids Both

Summer activities at the Goddard Institute for Space Studies include a fortuitous exchange of personnel between New York and the orient.

Dr. Hong Yee Chiu of the Goddard Institute is travelling extensively throughout the far east, while Dr. Tatsuzo Obayashi has come from Japan under the auspices of the National Academy of Sciences as a NASA Research Associate to study some aspects of solar-terrestrial relations at the Institute.

news from the Institute

Goddard Institute for Space Studies
475 Riverside Drive, New York, N.Y.

Dr. Hong Yee Chiu, a research scientist at the Institute and Adjunct Assistant Professor of Physics at Columbia University, is travelling at the invitation of Academia Sinica (the Chinese Academy of Sciences) for which he is a member, and with all expenses paid by the summer Institute in Taiwan. As visiting professor of physics, he is lecturing to a group of 80 seniors in physics and first year graduate physics students.

The summer institute in Taiwan is sponsored jointly by the National Taiwan University and the National Tsinghua University, along with the Academia Sinica.

On his way to Taiwan, Dr. Chiu delivered a lecture at Tokyo University on neutron stars, the theoretically predictable center left after the explosion of supernovae. Supernovae are exceptionally bright stars which vary dramatically in their brightness.

After the conclusion of the summer institute in Taiwan, Dr. Chiu will visit Hong Kong University and the Tata Institute of Fundamental Research in Bombay, India.

Dr. Chiu was recently awarded NASA's Distinguished Service Certificate for his pioneer research in the field of neutrino astrophysics.

Dr. Chiu joined the permanent research staff of the Goddard Institute in August, 1963, after two and one half years as a research associate for the National Academy of Science-National Research Council. He received his Ph.D. from Cornell University in 1959 and has also been associated with the Institute for Advanced Study, Yale University, Brandeis University and the University of Colorado.

A JAPANESE VISITOR

Dr. Tatsuzo Obayashi, a professor of physics at Kyoto University and a member of the staff of the University's Ionosphere Research Laboratory, will work at the Goddard Institute until October on several problems relating to solar-terrestrial relations.

These problems were extensively investigated for the first time during the International Geophysical Year (IGY). At the time of the IGY, the Sun's surface was at or near the most active portion of its eleven year cycle. Solar activity including Sun spots and solar flare eruptions were at their maximum.

These disturbances produce radiation and particle streams which affect radio transmission on Earth, distort this planet's magnetic field and also influence the Earth's ionosphere. Although the broad picture of solar-terrestrial relations has been clarified in recent years, the picture is far from being completely mapped.

Professor Obayashi's research is being carried out in connection with the International Years of the Quiet Sun (IQSY) which is a sequel and a complement of IGY. During the next two years, the Sun's surface activity will be at a minimum, as a new eleven year cycle begins.

One problem of concern to Dr. Obayashi is the study of the hydromagnetic waves in the magnetosphere which are excited by the arrival at the Earth of plasma clouds emitted from disturbances on the Sun's surface. At present, there is no satisfactory theory of the dispersion, or spread in velocities, of these waves as they travel along the geomagnetic lines of the magnetosphere. Dr. Obayashi's main interest is in the interaction between the magnetospheric plasma and the hydromagnetic waves.

It has become clear in the past few years, that substantial energy is transferred to the atmosphere by hydromagnetic waves. However, the mechanism and efficiency of this transfer is poorly understood. In the view of Dr. Obayashi, this is the most interesting theoretical problem of upper atmosphere physics.

This is the second extended visit that Dr. Obayashi is making to this country.

Dr. Obayashi is a member of the faculty of Kyoto University's Ionosphere Research Laboratory, where he teaches courses in electronics and ionospheric physics. He also teaches space physics at the University, and is active in the Japanese sounding rocket program.

Recent Technical Publications Authored by Goddard Staff

E. G. Bush, "The Use of Solid Circuits in Satellite Instrumentation," NASA Technical Note D-1758, July 1964.

J. M. Balderston, "Application of Integrated Circuits to Telemetry Systems," NASA Technical Note D-1905, July 1964.

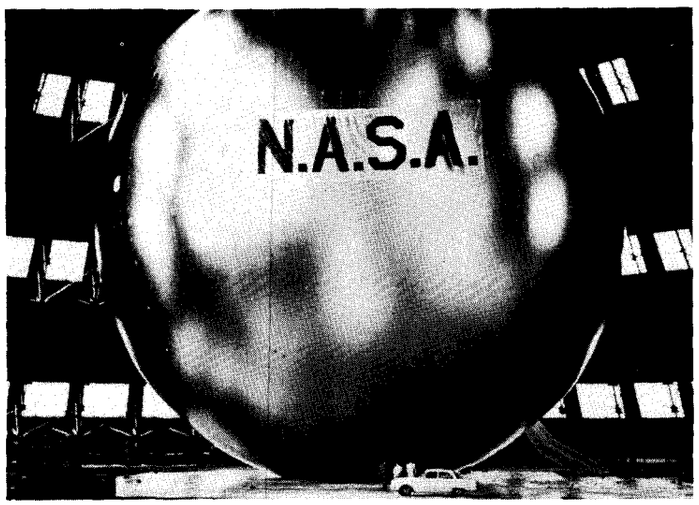
"Goddard Space Flight Center Contributions to the Cospar Meeting June 1963," NASA Technical Note D-2303, June 1964.

I. R. Shapiro, J. D. Stolarik, and J. P. Heppner, "Data Report on Whistlers Observed by Vanguard III (1959 η1)," NASA Technical Note D-2313, July 1964.

P. Musen, "On a Modification of Hill's Method of General Planetary Perturbations," NASA Technical Note D-2375, July 1964.

Malagasy Republic (Cont'd from p. 1)

Dr. Goett explains TIROS cloud cover patterns to the visiting head of state and the first lady.



News About Space & Aeronautics

● SERT-I (Space Electric Rocket Test), the 375-pound spacecraft to test an electric rocket in space, was flown on a sub-orbital trajectory atop a four-stage solid-propellant Scout vehicle last month.

Two electrostatic (ion) engines were mounted in the spacecraft to verify that such engines can produce thrust in space. This is possible only if the positive ion exhaust beam can be effectively neutralized. Methods of neutralizing the beam worked in ground vacuum tank tests but had to be verified in space.

Neutralizing is accomplished by injecting a stream of electrons into the ion beam as it rushes out of the back of the engine.

These electric engines operate by using electric power to create and accelerate small particles of propellant material to high exhaust velocities. The increased exhaust velocity, 10 to 20 times greater than that of conventional chemical rockets, greatly increases the "specific impulse," a miles-per-gallon-type figure for rockets.

Thus, a spaceship powered with electric rockets would be able to carry far larger payloads than conventional chemical rockets. Electric engines have a very small thrust, however, and are therefore not capable of lifting a spaceship from the surface of the Earth. Once lofted into orbit by chemical rockets, electric engines are capable of small, continuous thrust for periods up to several years.

• • •

● "I cannot contemplate the space exploration project—this all but unbelievable effort—without a tremendous surge of pride in the human race. We are going to the stars, gentlemen. The human race will travel to the planets and, in time, the other solar systems and in doing so will fan the spark of greatness which in spite of ourselves has carried us from the cave to the threshold of space.

"Man can go to the moon in this decade. The important question is, will it be an American?"—*William G. Gisel, President, Bell Aerosystems Company, before the New York State Society of Newspaper Editors, Niagara Falls, New York, June 14, 1964.*

• • •

● Either on the way to Mars or on the way back to Earth, the early explorers of interplanetary space may find it helpful to fly close to Venus.

The side trip would lengthen the voyage by a few months, conceded Paul G. Johnson of the Atomic Energy Commission-National Aeronautics and Space Administration Space Nuclear Propulsion Office, but the gravitational deflection from Venus also would hold the spacecraft to a safe speed for return to the Earth's atmosphere.

Echo Has Birthday Wednesday

Goddard's "grand old bag" of space—Echo I—is still going strong, providing scientists with a third generation of useful data.

August 12 will mark four years of orbiting for the first Echo balloon.

Echo was originally proposed as the follow-up to a 12-foot sphere launched unsuccessfully during the International Geophysical Year (1957-58). With a diameter of 100 feet, Echo was expected to be useful in measuring air density by a calculation of the effects of drag on an orbiting sphere.

But scientists for NASA's predecessor agency, the National Advisory Committee for Aeronautics, decided to coat it with a thin aluminum skin. This would enable Echo to bounce radio and facsimile messages from one point on Earth to another.

Echo I, launched in 1960, was highly successful. A second, larger Echo was orbited in January of this year. To insure a longer useful life, Echo II was given a tougher skin of aluminum and plastic to stay rigid even after bombardment by space meteoroids.

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.

"Our drive since Sputnik I has led skeptics to call the manned lunar program only a race to beat Russia. This is a fallacy. The Moon is not an advantageous spot from which to shoot nuclear-tipped missiles. We already have rockets that can hit the Soviet Union's interior in 20 minutes. Polaris missiles can hit Russia in one or two minutes, maybe less. It would take two and a half to three days for a Moon-based rocket to reach Russia.

"But the Soviet Union's design to rule the world makes it essential that we reach the Moon. This goal isn't, as skeptics argue, just a couple of weeks of good publicity. Sure, we have a signed United Nations agreement forbidding any nation from claiming the Moon or space as a colony. But Russian domination of the Moon would equate, in world opinion, the dominance of all space. We can't afford that false impression. The nation that retains space superiority holds an immeasurable psychological advantage. Space feats are an index of a country's strength. If Russians were the only earthmen on the Moon, you'd hear people around the world saying, 'If they can do that, no telling what they can do to us!'"

—*Article by Senator Clinton P. Anderson, Pageant, July 1964.*

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

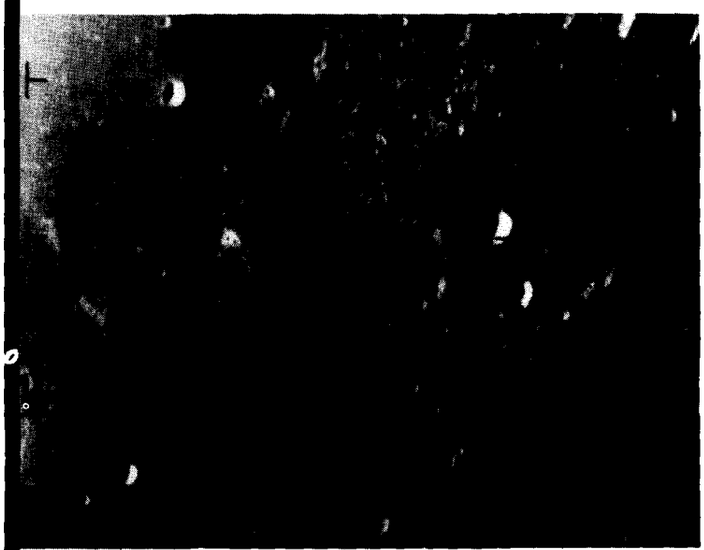
The Goddard News is a bi-weekly publication of the National Aeronautics and Space Administration's Goddard Space Flight Center, Greenbelt, Md., suburban Washington, D. C. Phone—Ext. 4141 or 4142

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

Historic Ranger Pictures

Features of the Moon 1000 times smaller than ever observed by man in the past are distinguishable in pictures returned by Ranger 7's cameras during its highly successful mission.

1) This photo, first in a series released, was taken from an altitude of 480 miles. It duplicates closely resolution obtained in earth-based photography.



2) 470 miles: The smallest craters in this photograph are about 800 feet in diameter. An area 78 miles on a side is shown.

3) From an altitude of 235 miles: The smallest craters are about 100 feet in diameter.

This performance was approximately 100 times better than Jet Propulsion Laboratory scientists predicted prior to the historic moment when the first photo was processed. The most important single result of the mission is the fact that Ranger pictures showed no roadblocks to the manned lunar landing program.

NASA scientists who made a preliminary study said that the dust on the surface seemed to measure "inches rather than feet as some of us had expected." The depth of lunar dust was one critical item in the design of the LEM (Lunar Excursion Module) for Porject Apollo.

Marksmanship

The Ranger spacecraft benefited from a near-perfect launch, which made only relatively minor mid-course correction necessary. The launch was managed by Goddard's launch operations branch at Cape Kennedy, headed by Bob Gray.

From a "storybook" launch to the final moment of silence when the spacecraft impacted on the Moon and suddenly ceased transmission, the mission went smoothly. In light of the complexity of the project and the many possibilities for failure, Ranger 7's success appears even more formidable.

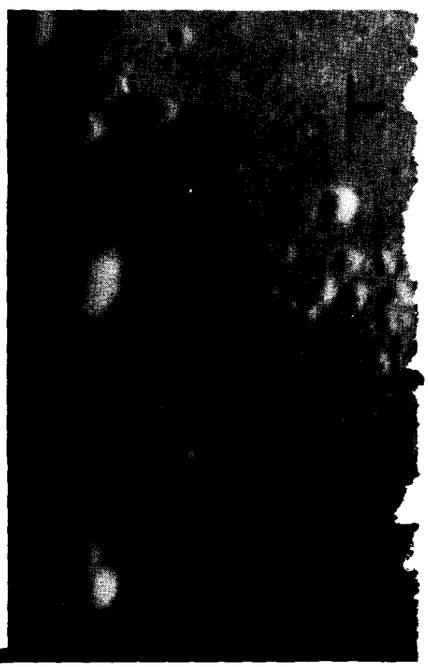
A writer in the Philadelphia *Evening Bulletin* described the role of Ranger in colorful terms: "It is a question of looking at the face of the Moon, figuratively speaking, knowing that the eyes, nose, ears and mouth already have been seen through telescopes from the Earth."

Ranger's job, in the above context, was to make visable "small scars or blemishes, freckles, wrinkles, moles and warts. . . ."

Now that the launch people, the guidance and control personnel, communications experts and the team responsible for the development and testing of the spacecraft have seen fruition, an ardous task begins for scientists who will evaluate the more than 4000 pictures.

This work will take months and perhaps years; and when it is finished, pictures from upcoming Ranger and Surveyor missions will be ready and waiting--a continuing challenge.

4) (above) and 5) 85 mil one below are quite similar, in distance. Craters as sma



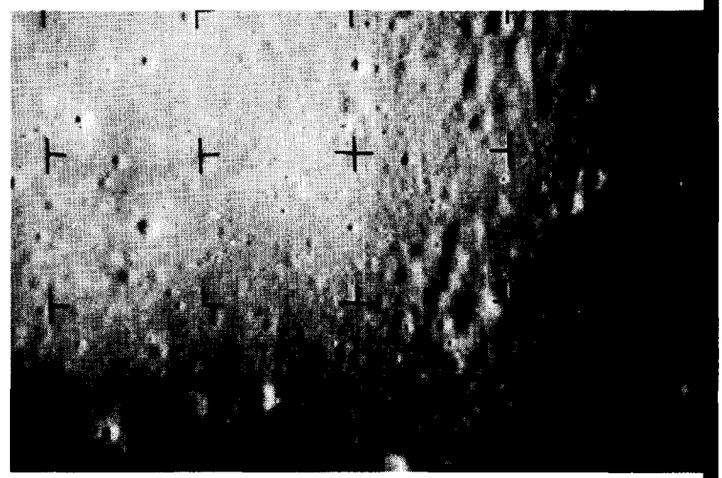
—They Pinpoint 'Pimples' on Moon's 'Face'...

Goddard Team Manages Launch

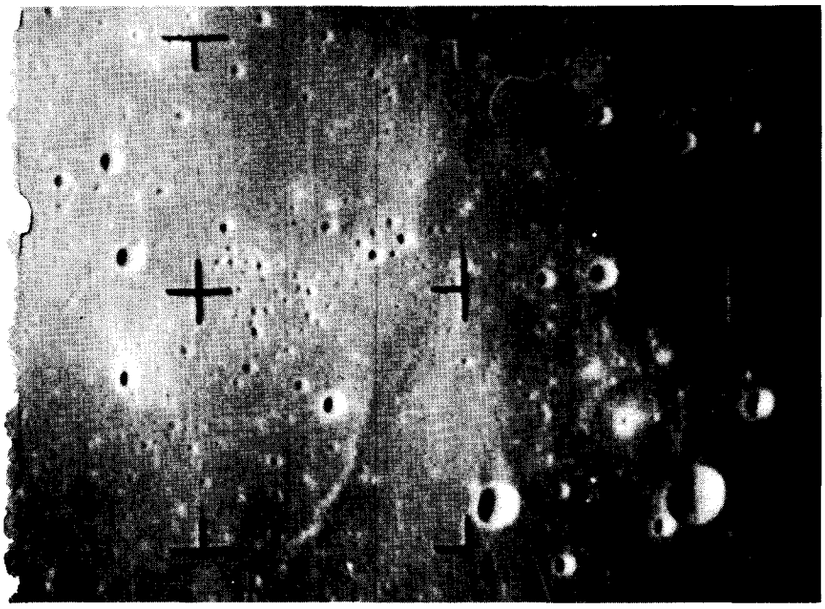
A 25-man-team from the Goddard launch operations branch, headed by Robert M. Gray, directed the historic launch of Ranger 7 from Cape Kennedy July 28.

With the marksmanship of a sharpshooter the Agena vehicle impacted less than 10 miles from its intended target after a 228,600-mile flight from complex 12 at the Cape.

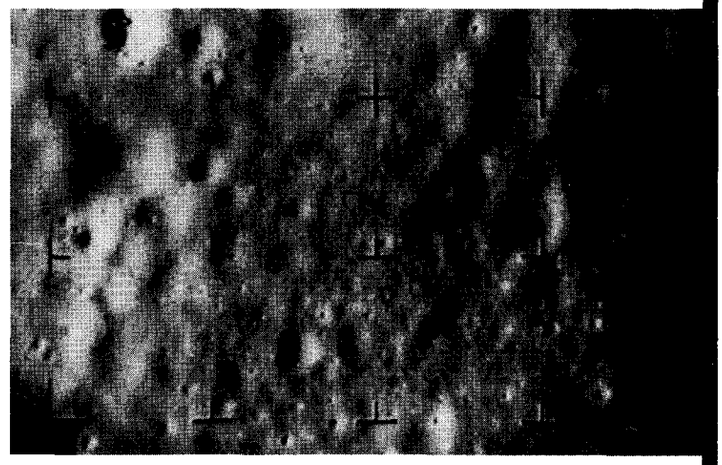
Ranger 7 marked the 33rd orbital attempt by the Goddard branch which is responsible for all unmanned satellite launchings from the Cape and Pacific Missile Range using the Delta, Atlas and Thor Agena and Centaur rockets. Twenty-eight of these went into orbit.



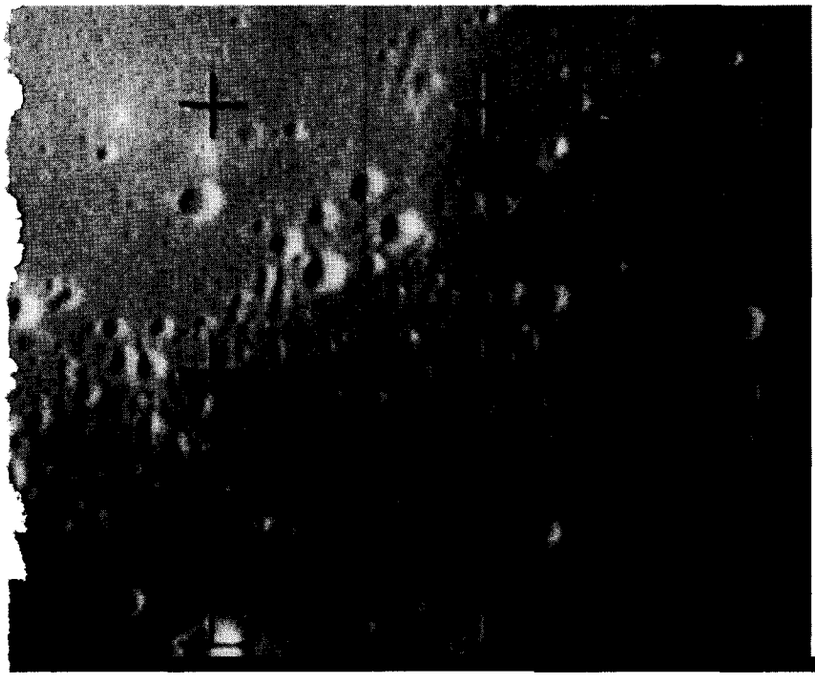
6) The area shown here, from an altitude of 11 miles, is a close-up of the region just below and left of center in picture number 5. The area shown is four miles on a side.

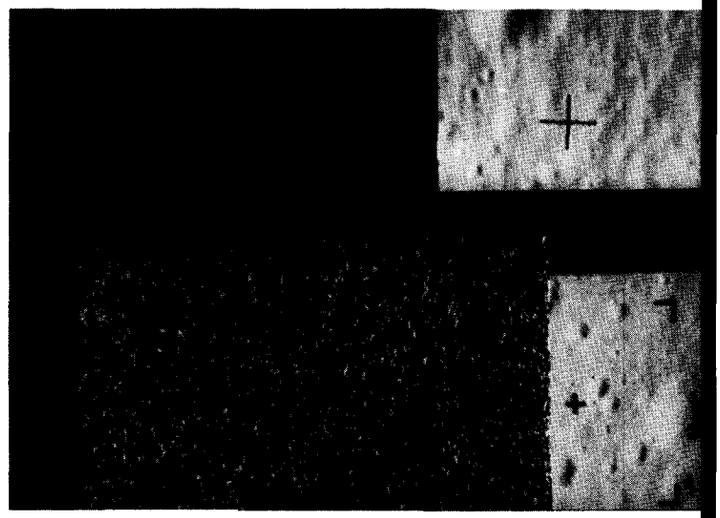


es and 34 miles altitude: The clarity of the picture above and the but the size and resolution of the craters point up the differences l as 500 feet in diameter are visable above.



7) This extremely clear photo was taken when Ranger was just three miles above the surface. Note the angular rock mass in the crater in the upper left-hand corner.





8) 3000 feet and 1000 feet: The top picture was snapped by Ranger at an altitude of 3000 feet. The lower picture is a partial shot with lines of receiver noise at the left. It was never completely transmitted before crash landing. Its three-foot craters represent a resolution 1000 times better than anything visable from Earth.

Telemetry Connects Experiment and Experimenter

When a scientific satellite is hundreds of miles away from Earth, there are numerous things the experimenter would like to know about what is happening at the satellite at every instant in every experiment. And, naturally, he would like to have an unlimited number of experiments aboard.

Just as naturally, there is a limitation placed on how much information can be sent back due to practical considerations of weight, available power, cost, and other natural laws. If this were not true—Ranger would have carried more than a few cameras, for example.

So the experimenter must decide what minimum number and what kind of measurements will be required for furthering mankind's knowledge of the universe.

Some of the most common things experimenters want to know are: how many micrometeorites are in space; what is the temperature in different parts of the satellite; and what direction is the satellite pointing. Each one of the instruments for measuring these quantities is called a sensor and the measurement from a sensor is called a "channel," according to Clarence B. House, flight data systems branch.

"Since we want to send as many channels as possible, we have to think of some way to share the available transmitting power. This 'sharing' is done by the the telemetry encoder," he explained.

However, there are different methods of doing this channel sharing (called multiplexing). The result of the multiplexing process in the encoder is that all different kinds of information can be transmitted over one wire or one radio frequency transmitting band.

Each of three systems of telemetry encoding in use at Goddard has several advantages and corresponding disadvantages.

The most widely used multiplexing system has been **FM/FM** which sends analog data exculsively. With this method of coding the condition of the sensor causes a frequency to be generated. As the condition changes, the frequency changes. This is called Frequency Modulation and operates somewhat the same way as your regular FM station.

In FM/FM multiplexing, you can imagine that each information source has its own tiny transmitter with its assigned carrier frequency which is modulated by the sensor. These modulated carrier channels are then all mixed together in the encoder and the conglomeration is used to modulate the real (or main) transmitter. Usually his transmitter is also frequency modulated, so the name FM/FM telemetry has become standard.

A second method of telemetry encoding and multiplexing which is presently gaining in popularity is **Pulse Code Modulation.** PCM only transmits binary information. Binary refers to a number system to the base 2 as compared to our common decimal system which is based on the number 10. The binary system is rather cumbersome but it is becoming widely used because it can be so easily used by computers and coding systems such as PCM.

In the binary system each digit in a line of digits which compose a number can be a value of "zero" or a value of "one." Then in a coding system the digit may have two states representing a one or a zero and the value of the digit may be represented by its position in a train of zeros or ones. Usually the first digit in a "word" following the Identification is the most important digit, just as you ordinarily say the number "100 and something."

The next pulse is the next most important digit and so on until all digits or bits assigned to that word have been transmitted. In this manner the Pulse Code Modulation system time multiplexes different channels of information and sends them back to the receiver and decoder.

The third method, **Pulse Frequency Modulation,** combines features of both FM/FM telemetry and Pulse Code Modulation. That is, it multiplexes channels of information in time (similar to PCM) and not in channel as FM/FM does.

First, an I.D. tone is sent to tell the receiver that the next tone (in time) will tell how many micrometeorites have been counted; the next tone in time will tell the temperature and the next tone will tell us in which direction the Sun is placed for example.

While PCM telemetry only sends back numbers in binary form, or what is sometimes also called digital information, PFM telemetry can also send back binary or digital information.

That is part of the similarity of PFM and PCM. The difference is that we can also send analog information with PFM just as we can with FM/FM. The two types of information—digital and analog—can be intermixed in the PFM system and we then time share in any

(Cont'd on p. 7)

Goddard Speech and Paper Presentations

(Technical presentations approved as of August 3, 1964 for period through August 23. Requests for copies of speeches and papers should be made directly to the author.)

PAPERS

S. Ishtiaq Rasool, International Union of Geodesy and Geophysics (International Symposium on Radiation), August 5-20, Leningrad, Russia, ***"Heat Balance of the Atmosphere and the General Circulation."***

Kaichi Maeda, IQSY Regional Symposium, August 3-8, Buenos Aires, Argentina, ***"On the Zenithal Distribution of High Energy Cosmic Ray Muons on the Atmosphere," "Diffusion of Auroral Electrons in the Polar Atmosphere,"*** and ***"Infrasonic Waves and Auroras."***

J. P. Heppner, IQSY Regional Symposium, August 3-8, Buenos Aires, Argentina, ***"Review of Space Magnetic Field Studies."***

R. A. Hanel, Radiation Commission of IAMAP, August 5-20, Leningrad, Russia, ***"Radiative Equilibrium in Planetary. II. Effects of Carbon Dioxide & Water Vapor Absorption in the Atmosphere of Venus."***

W. R. Bandeen, International Association of Meteorology and Atmospheric Physics (IUGG), August 5-12, Leningrad, Russia, ***"A Radiation Climatology in the Visible and Infrared from the TIROS Meteorological Satellites."***

W. G. Stroud, Radiation Commission Conference (IUGG), August 5-12, Leningrad, Russia, ***"Radiometric Systems for Meteorological Satellites."***

Abe Kampinsky, Ninth Symposium on Ballistic Missile and Space Technology, August 12-14, San Diego, Calif., ***"Signature of Passive Communication Satellites."***

William J. Healy, UAIDE (Users of Automatic Information Display Equipment), August 12-14, Los Angeles, Calif., ***"Integration of Display Devices into the Real-Time Control of a Satellite Tracking Network."***

M. Mahoney & J. Quann, UAIDE (Users of Automatic Information Display Equipment), August 12-14, Los Angeles, Calif., ***"The Actual Motion and Orientation of an Orbiting Spacecraft Viewed in the Form of a Motion Picture."***

W. T. Kitts, 1964 Cyrogenic Engineering Conference, August 17-21, Philadelphia, Pa., ***"Experiment Studies of Oscillations Observed in Liquid Helium,"*** and ***"Development of a Cyrogenic Connector for Space Simulation Chambers."***

G. D. Mead, Symposium on Ultra Low Frequency Electromagnetic Fields, August 17-20, Boulder, Colo., ***"The Magnetopause."***

T. Neil Davis, Symposium on Ultra Low Frequency Electromagnetic Fields, August 17-20, Boulder, Colo., ***"Optical Pulsations in the Aurora."***

Masahisa Sugiura, Symposium on Ultra Low Frequency Electromagnetic Fields, August 17-20, Boulder, Colo., ***"Hydromagnetic Wave Propagation."***

A. Boggess III, Interntional Astronomical Union, August 18-19, Liege, Belgium, ***"Ultraviolet Fluxes from O, B and A Stars."***

P. Musen, International Astronomical Union, August 17-22, Thessaloniki, Greece, ***"On a Modification of Hill's Method of General Planetary Perturbations."***

J. K. Alexander, International Astronomical Union, August 12-18, Liege, Belgium, ***"Design of a Radio Astronomy Satellite for Low Frequency Cosmic Noise Observations."***

Bertram Donn, International Astronomical Union, August 17-20, Hamburg, Germany, ***"Chemistry of Cometary Nuclei and Atmospheres"*** and ***"Possibilities of Cometary Research by Means of Space Experiments."***

Myron Lecar, International Astronomical Union, August 17-22, Thessaloniki, Greece, ***"One Dimensional Selfgravitating Gas."***

K. L. Hallam, International Astronomical Union, August 17-20, Saltsjöbaden, Sweden, ***"Two-Dimensional Classification of OB Stars by Means of 7 Color Photometry."***

Telemetry

(from p. 6)

manner the system designer may wish.

In an overall comparison PFM is more like PCM than FM/FM and requires less complexity at the transmiting station.

The general plan of application at Goddard is to use PCM in large multi-experiment (observatory) satellites such as OGO and OSO, and use PFM in smaller, restricted weight satellites such as some of the Explorer series and some of the international satellites.

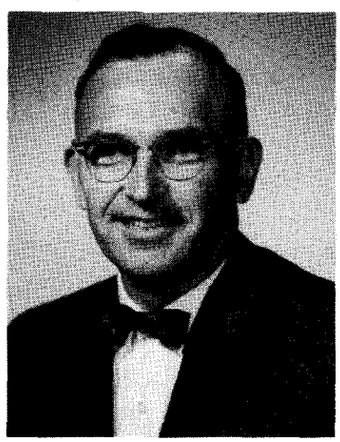
Bill Cherry Receives Award

William R. Cherry, head of Goddard's space power technology branch, received a cash award of $1000 for "initiating and supervising the early investigation of the 'N-on-P' type solar cell . . . and . . . development of efficient cells of that type . . ." according to James A. Hootman, executive secretary, NASA inventions and contributions board.

Mr. Cherry's immediate family was also invited to the awards presentation ceremony last Wednesday in federal office building six.

He heads a 40-man branch here with the responsibility for design and development of spacecraft power systems as well as support, research and development of improved space power systems.

Cherry has been at the Center since October, 1962. He was previously employed at NASA Headquarters, and prior to that he worked at the U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J. from 1951 to January, 1962.

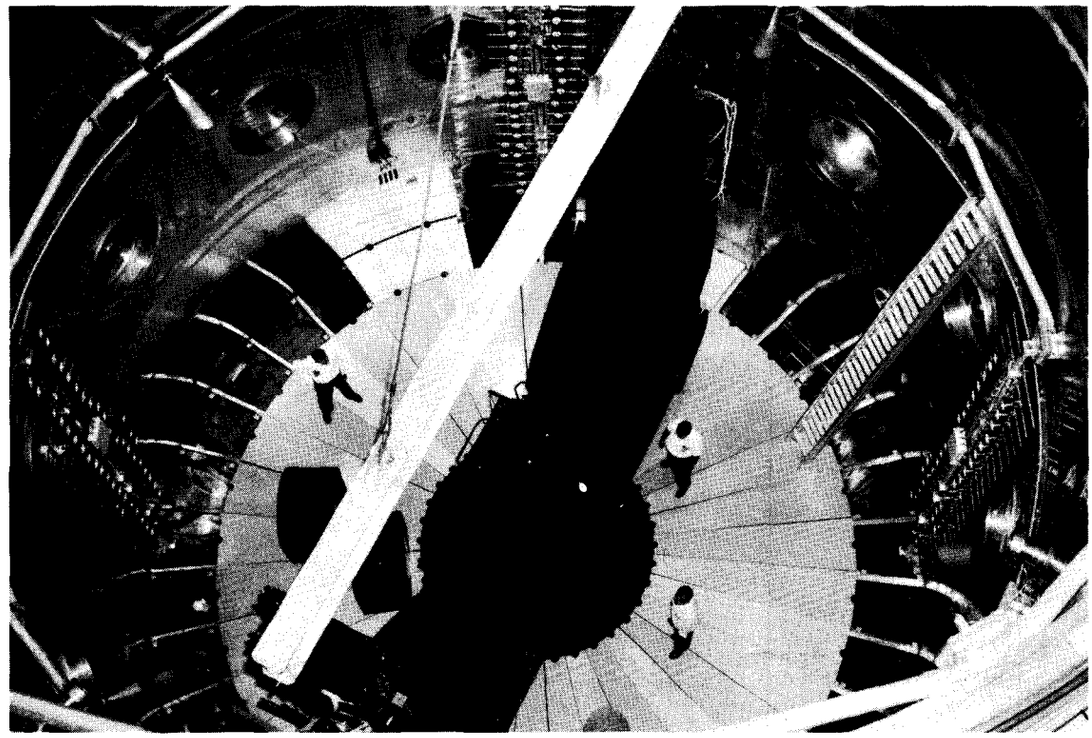


William R. Cherry

Goddard Coming Events

Demonstration of Equipment

- **August 11, 10:30 a.m.-3:30 p.m., Parking Lot behind Bldg. 1, AMP, Inc., *"The latest developments in the wire termination technique. Logic modules, programming systems both universal and full shielded, diode pinboards and manual card programming devices. A complete line of rack and panel connectors, micro circuit packaging hardware, c o a x i a l and printed circuit connectors."***
- **August 12, 9:30 a.m.-3:30 p.m., Conference Rm, B l d g 8, Friden, Inc., *"Friden, Inc., new desk calculator Model 130 which which is reported to have many advantages over its mechanical predecessors. The new calculator is especially applicable in solving engineering and statistical problems."***



Spacecraft Positioner (Above) Gets Dry Cleaned

A massive dry cleaning job was handled in routine fashion in building 10 last month.

The large black object pictured here being lowered into test and evaluation division's Dynamic Test Chamber (DTC) for cleaning is the spacecraft positioner (see story, "Swingin' Horseshoe . . .", June 1 issue, p. 6).

A vacuum was created in the huge chamber with the positioner inside, and the resulting "outgassing" did the cleaning job on the horseshoe-shaped metal U-frame.

The large-scale "dry cleaning" was necessary to prevent the positioner from contaminating the ultra-clean Space Environment Simulator (SES) when it is placed there for test purposes. The positioner will be used to orient spacecraft under test conditions within the SES.

Papers Solicited For Nov. Symposium

Original papers are being solicited for a **Symposium on the Definition and Measurement of Short Term Frequency Stability** which will be held here at Goddard on November 23 and 24.

The symposium is to be jointly sponsored by this Center and the Institute of Electrical & Electronics Engineers, Inc.'s Technical Committee 14, Standards—Piezoelectric and Ferroelectric Crystals, according to Goddard's Andrew Chi, chairman of the symposium.

Original papers are sought on the following subjects:

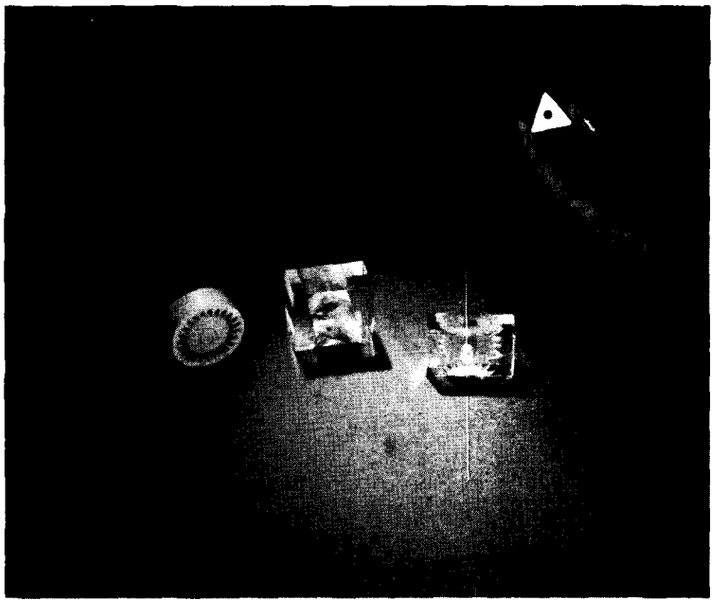
- System requirements for short-term frequency stability;
- Theory of oscillators' bearing on short term stability measurements; and
- Device characteristics and measurement techniques.

Other members of the symposium program committee represent industry, DOD, and Marshall Space Flight Center.

Those who have special requirements on the short term frequency stability of oscillators should submit them to Dr. Friedrich Vonbun, systems analysis office, who will present a paper summarizing the Goddard requirements.

Any member of the scientific community interested in submitting a paper or attending the symposium should contact Andrew Chi or Charles Boyle, Code 207, extension 5006.

Ultrasonic Machine can Drill into 'Unmachinable' Materials



Here are some examples of machining in "unmachinable" materials which have been done at Goddard using the new ultrasonic machine tool in building 5.

Cavities in any configuration and holes of all sizes can now be machined quickly and inexpensively in carbides, ferrites, ceramics, and other materials often dubbed "unmachineable."

This new capability became possible with the acquisition of a special type of ultrasonic transducer. By using this instrument, surfaces can be maintained within a tolerance of .005 of an inch. It is also possible with this technique to simultaneously machine multiple cavities.

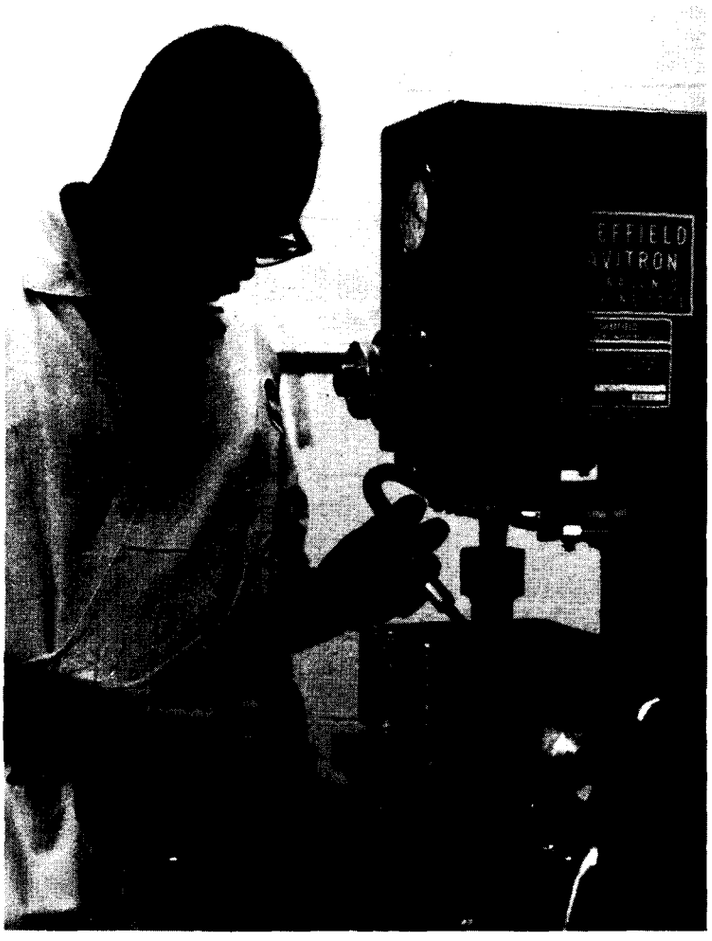
Basically, the machine consists of a worktable, tool holder, a magnetostrictive armature vibrating a tool at ultrasonic frequencies (between 20,000 and 50,000 cycles per second), and a system for delivering an abrasive slurry, such as boron particles, to the work.

Driven by a high frequency electrical generator, the abrasive grit is forced into the workpiece and abrades away minute particles. Tools with cross sectional areas from .005 to 3½ inches can be used to make cuts as deep as 5 inches.

Other capabilities of the new equipment permit the repair of hardened steel dies without annealing, assurance of high uniformity in duplicating pieces, and the retention of the original metallurgical properties of the material being machined.

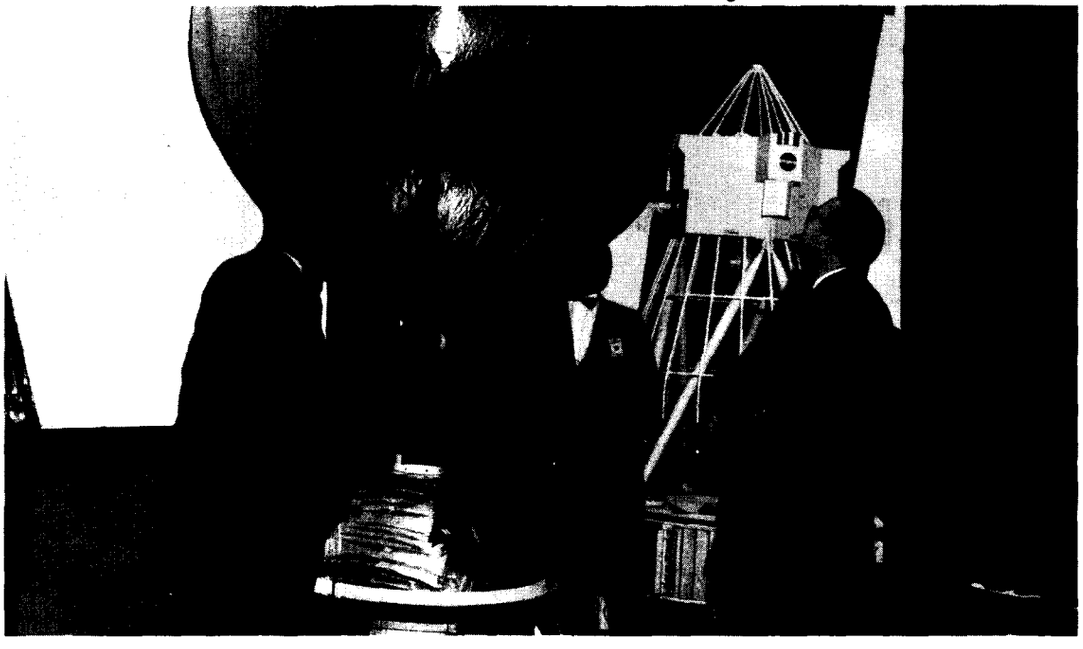
Safety and ease of operation are other attributes, since there are no exposed electrical circuits or hazardous moving parts.

Acquisition of the new ultrasonic instrument opens up new dimensions of fabrication at Goddard, and permits designers much greater latitude in their increasingly sophisticated demands upon the fabrication division.



Nathaniel Price, machine shop, is shown here using the ultrasonic machine tool for machining a ceramic configuration.

German News Bureau Chief Sees Center



John H. Howard, public information office (left) is discussing a scale model of Echo I with Wolfgang Nolter (ctr.), chief of the German News Agency Washington Bureau. Hans Jurgen-Hofer, also of the Washington Bureau, is at right.